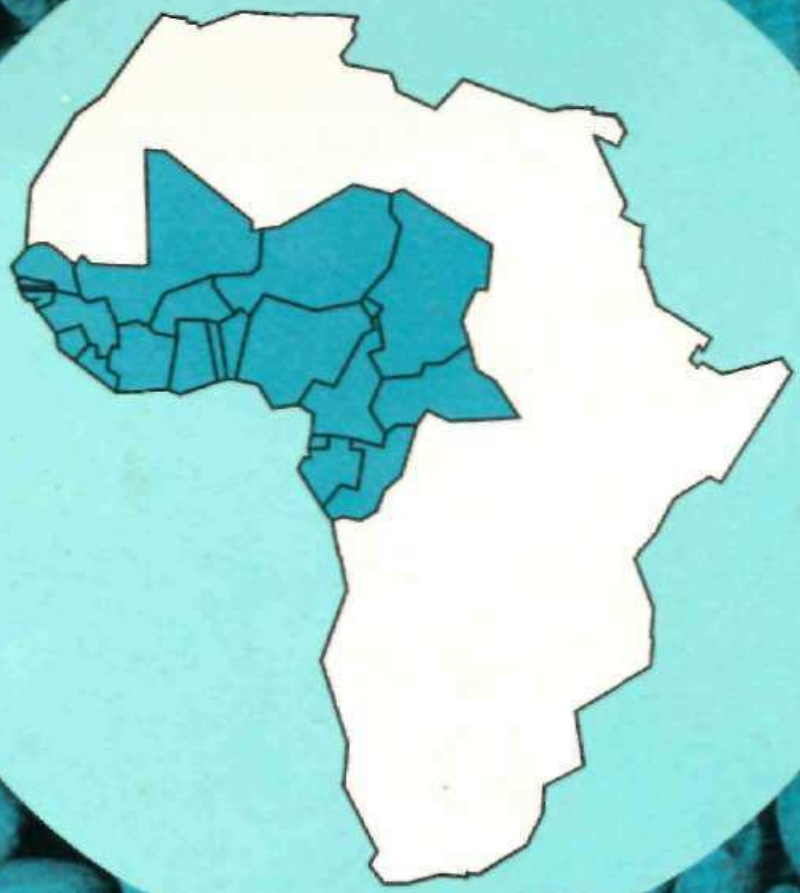
Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa



International Crops Research Institute for the Semi-Arid Tropics

Abstract

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. (In Eng., Fr.) Patancheru, A.P. 502 324, India: ICRISAT. Eng.: 76 pp.; Fr.: 84 pp. ISBN 92-9066-212-3.

Representatives from 16 countries as well as regional and international organizations concerned with groundnut production and research in West Africa attended a meeting at Sadore near Niamey to follow up on the recommendations made during the first meeting held in 1988 as well as review the progress made in groundnut research since then.

Presented in this volume in English and French are the welcome and opening addresses, summaries of 31 papers and recommendations. Papers reviewed groundnut research on agronomy and production, breeding, pathology, and utilization.

Resumen

Citación: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Compendio de Actas de la Segunda Reunión Regional de ICRISAT para el Africa del Oeste Sobre Maní, 11-14 de Septiembre 1990, Centro Sahelliano ICRISAT, Niamey, Niger. (En Inglés, Francés). Patancheru, A.P. 502 324, India. Inglés: 76 p.; Francés: 84 p. ISBN 92-9066-212-3.

Representantes procedientes de 16 países así como desde diversas organizaciones internacionales y regionales relacionadas a la producción y la investigación del maní en el Africa del Oeste asistieron a una reunión en Sadoré cerca de Niamey con el objetivo de proseguir las recomendaciones hechas durante la primera reunión celebrada en 1988 así como para analizar el progreso alcanzado en las investigaciones sobre el maní desde entonces.

Este tomo consta de los discursos de bienvenida y apertura, resumenes de 31 ponencias y las recomendaciones. Las ponencias examinaron las investigaciones sobre maní en las áreas de agronomía y producción, selección, patología y utilización.

Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa

11-14 Sep 1990
ICRISAT Sahelian Center
Niamey, Niger

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics
Patancheru, Andhra Pradesh 502 324, India

1991

Organizing Committee

R. W. Gibbons, B. J. Ndunguru, and F. Waliyar

Scientific Editors

B. J. Ndunguru, F. Waliyar, and B. R. Ntare

Publication Editor

Savitri Mohapatra

Cover: P. Satyanarayana

Typography : K.K. Purkayastha and K. Chandrasekhara Rao

ISBN 92-9066-212-3

Contents

Pathology

Utilization

General

Appendixes

Preface

The purpose of the meeting was to follow up on the recommendations made during the first meeting held in 1988 as well as review the progress made in groundnut research. The meeting was jointly sponsored by ICRISAT and Peanut Collaborative Research Support Program (CRSP). The West African countries represented were : Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, the Gambia, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. Also represented were the Peanut CRSP, Institut de recherches pour les huiles et oleagineux (IRHO), Institut francais de recherche scientifique pour le developpement en cooperation (ORSTOM), Food and Agriculture Organization of the United Nations (FAO), ICRISAT Center, SADCC/ICRISAT Regional Improvement Program, and ICRISAT Sahelian Center (ISC). Fifty-two participants attended the meeting, and 31 papers were presented. Participants visited our trials at the Institut national de recherches agronomiques du Niger (INRAN) Station at Bengou and Tara. Recommendations from the working groups (Agronomy, Breeding, Pathology, and Utilization) were discussed and approved at the plenary session.

These proceedings comprise summaries of papers presented at the meeting. Full papers are available on request from the Program Leader, Groundnut Improvement Program, ICRISAT Sahelian Center, B.P. 12404, Niamey, Niger (via Paris).

Welcome Address

A.M.B. Jagne[1]

Honorable Minister, distinguished visitors and colleagues, ladies and gentlemen,

The Executive Director, West African Programs, and Director, ICRISAT Sahelian Center, Mr R.W. Gibbons had to travel to ICRISAT Center, India, to participate in External Program and Management Review panel meetings. He regrets very much that he is not here in person to welcome you to ISC and to the Second ICRISAT Regional Groundnut Meeting for West Africa. As the Acting Executive Director, it is my privilege and pleasant duty to welcome you on his behalf.

Honorable Minister, distinguished visitors, we are honored and encouraged by your presence here; it is to us a manifestation of the esteem in which you hold ICRISAT and of the importance you attach to this meeting.

ICRISAT, as one of the International Agricultural Research Centers (IARCs) sponsored by the Consultative Group on International Agricultural Research (CGIAR), remains committed to the goal of increasing sustainable food production in the semi-arid tropics so that the nutritional level and general economic situation of low-income people are improved. It has a mandate to:

1. improve the grain yield and quality of sorghum, millet, chickpea, pigeonpea, and groundnut and to store the genetic resources of these crops;
2. improve farming systems and stabilize agricultural production through more effective use of natural and human resources in the semi-arid tropics;
3. identify constraints to agricultural development and alleviate them through technological changes; and
4. work with national and regional research programs to develop technology and transfer it to the farmer.

It is in the context of the effort to work with national and regional research programs that we are assembled here. All of you, eminent scientists present here—from the NARS, ICRISAT Center, SADCC, and ISC—have a common objective: to cooperate and assist in the development and transfer of technology to groundnut farmers. We are all well aware of the importance that groundnut production continues to have in the economies of the Sahelian countries. It provides an important source of food and income to Sahelian farmers.

I would like to express our gratitude to you all for responding favorably to our invitation to participate in this meeting and for your willingness to share your knowledge of the constraints that have inhibited growth in groundnut production and your ideas about how to overcome them. It is through the exchange of ideas and experience that we can hope to make rapid progress in the effort to reverse the declining trend in production and to increase sustainable production. This meeting is intended to provide an opportunity and a forum for such an exchange. We look forward to a fruitful and rewarding meeting.

---

1. Regional Administrative Officer, ICRISAT Sahelian Center, B.P. 12404, Niamey, Niger.

I would like to take this opportunity to express our gratitude to the Honorable Minister for his kind disposition to assist and support ICRISAT. We are most grateful to you, Sir, and would appreciate it very much if you will kindly convey to the Government of the Republic of Niger our thanks for the interest it continues to show in the activities of ICRISAT.

Once again, welcome to you all and thank you for coming to this meeting.

Opening Address

A. Aboubakar[1]

Honored guests, distinguished delegates, ladies and gentlemen,

On behalf of the Government of Niger, I take personal pleasure in welcoming you to the Second ICRISAT Regional Groundnut Meeting for West Africa. I wish you a pleasant stay in Niger and hope that this event will enable you to know our country better. I would like to thank ICRISAT and the Peanut CRSP for their financial support, without which this meeting could not have taken place.

Niger's agricultural sector contribution to the gross national product fell sharply from 68% to 47% between 1965 and 1985. This was mostly due to the increased importance given to uranium mining. Nevertheless, the number of people engaged in agricultural work remains very high; nearly 90% of the population depends for its livelihood on agriculture and livestock breeding.

Agriculture is still mostly devoted to producing food crops. The main crops grown are millet and sorghum. Rice production is less important than that of cowpea which is a traditional food crop that has increased production steadily since the early eighties and has overtaken groundnut production since 1976-77. Estimated marketed volume of local grains is between 10-15% of production with some yearly variations.

In his opening statement at the First ICRISAT Regional Groundnut Meeting for West Africa in Sep 1988, my predecessor said that before the severe drought in 1973, groundnut production ranked third in the country. The area under groundnut cultivation was 423 000 ha in 1968. In 1966, groundnut production was estimated at 312 000 t, i.e. an average of 880 kg per hectare. Research has played a vital role in increasing production but the Government has also contributed by establishing the National Marketing Corporation (SONARA), to lend support to groundnut production, processing, and marketing.

Although groundnut exports have fallen, the crop is very important to the country. It is valuable for its high protein and oil content. It is valuable both as a source of food and feed.

The first meeting in 1988 had two aims: 1) to give participants an opportunity to share their experience of groundnut production and its improvement in the different countries of the region and 2) to identify areas in which joint research could be developed. I am pleased to see that these two objectives have been attained. The first workshop also enabled you to meet regional researchers. At the end of the first workshop, you made recommendations and you would like to follow up these to see how they have been implemented since the last meeting and to find where the difficulties lie.

We are very pleased that the ICRISAT Sahelian Center has worked out a program which is aimed at working together with all the groundnut scientists in the region. We pay tribute to this work and we await the improvement in groundnut production in the region with eagerness. I strongly believe that the strategies of the researchers present today, coming as they do from national, regional, and international programs, will be duly studied so as to increase groundnut production.

With the conviction that your deliberations will be most rewarding, I hereby open the Second ICRISAT Regional Groundnut Meeting for West Africa.

Thank you.

---

1. Minister for Higher Education, Research, and Technology, Republic of Niger.

Groundnut Production and Research Needs In Sierra Leone

A. Sesay[1]

Groundnut *(Arachis hypogaea* L) is the most extensively cultivated legume in Sierra Leone and provides a significant source of protein for the majority of the population. However, farm yields and total production have remained low while domestic demand has increased considerably, resulting in high local market prices. The major factors contributing to the low groundnut production in Sierra Leone are:

- lack of improved and high-yielding varieties;
- yield losses due to diseases and pests;
- prevalence of traditional production methods;
- lack of reliable technology specific to groundnuts.

Currently, Mares and Gambay are the two established landrace cultivars grown in Sierra Leone. These two cultivars are low-yielding, small-seeded and highly susceptible to the principal diseases.

The major groundnut diseases in the country are the leaf spots *(Cercospora arachidicola* Hori) and *(Phaeisariopsis personata).* A yield loss of 47% due to these diseases was recently reported.

The incidence of groundnut rosette is widespread but sporadic, and recent observations have shown an increase in the incidence of wilt caused by *Fusarium* sp and *Sclerotium* sp. Rodents *(Xerus erythropus* and *Rattus rattus),* bush fowls *(Francolinus* sp), monkeys *(Cercopitheus* sp) and the olive baboon *(Papio anubis)* are the major pests.

The bulk of the crop is grown with very low inputs and harvested during the rains between Aug and Sep; drying is thus a slow process. There is a total lack of adequate field experimental evidence on which reliable extension recommendations could be based. To increase groundnut production in Sierra Leone, there is an urgent need to make a sustained and coordinated research effort on the broad areas of a) varietal improvement; b) development of improved management practices; and c) development of labor-saving implements. In this connection an intensive and coordinated groundnut research program has been started within the Institute of Agricultural Research, based at Njala, and in collaboration with the ICRISAT Sahelian Center. The initial focus is on varietal improvement. For the short term, it is hoped that this objective could be achieved by selecting from local and exotic genotypes and by using exotic genotypes that show exceptionally high adaptability and yield potential.

1. Associate Scientist, Department of Biological Sciences, Institute of Agricultural Research, Njala University College, P.M.B. Freetown, Sierra Leone.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Survey of Groundnut Agronomic Practices in Niger

B. J. Ndunguru[1]

Groundnut (*Arachis hypogaea)* was introduced to West Africa by Portuguese traders and was cultivated in Niger before the end of the last century. Since its introduction in Niger, groundnut production has gone through three stages: expansion (1930 - 59), upsurge (1960 - 72), and decline which started in 1972. Guaranteed markets, use of improved varieties, fungicides, and phosphate fertilizers contributed to increase in production. The upward production trend was reversed when France guaranteed to purchase only a certain quota of the produce every year. This, coupled with 1973/74 drought that wiped out the groundnut crop, and the severe rosette epidemic in 1975 and 1987, made it impossible to reach peak production levels. Presently Niger's production target is to sustain an appropriate level of self-reliance in food production. We conducted a survey in the major groundnut-growing areas in Niger during the 1988 cropping season.

The aim was to obtain information that can be used as benchmark data from which changes in basic farm operations can be measured and to identify development constraints and/or opportunities.

Survey Results

Land Preparation

Groundnut was generally grown in small plots, less than about 1.5 ha. Generally over 80% of the groundnuts are grown in rows on the flat, at a row-to-row distance of 40 to 50 cm and a plant-to-plant spacing of 30 cm. Around Tara, Department of Dosso, about 32% of the farmers grow their groundnuts on ridges, which are normally made with animal traction.

Seed Source

Three seed sources were identified: 1) purchases from cooperatives; 2) purchases from the market; and 3) stocked seeds from previous harvests. The percentage of farmers purchasing seed from cooperatives was high (50%) in Maradi and lowest in Tahoua (20%). The percentage of those purchasing seed at the market was highest in Tahoua (60%) and lowest in Zinder. In Zinder, 56% of the farmers stocked their own seeds whereas in Dosso, only 46% stocked their own. On the whole, 33% bought their seeds from cooperatives, 30% from the market, and 37% stocked their own.

1. Principal Groundnut Agronomist, ICRISAT Sahelian Center, B.P. 12404 Niamey, Niger (via Paris).

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Sowing Dates

Sowing dates varied from 25 May to 28 Jul in Dosso, 10 Jun to 7 Jul in Maradi, 2 Jun to 2 Jul in Zinder, and 11 Jun to 1 Jul in Tahoua. These dates were fixed more or less according to the onset of rains. Groundnut was sown after the rains had stabilized.

Sowing Methods

Almost all sowing in Dosso, Zinder, and Tahoua was done by hand. Machine sowing was practiced only in Maradi by about 27% of the farmers. Total dependence on labor for sowing naturally restricted the farm size.

Cropping Systems

In our survey, we found that there was a general tendency to grow groundnut in association with other crops. About 66% of the farmers grew groundnut in association with millet, sorghum, cowpea, and kenaf. The most common intercropping was groundnut/millet or groundnut/sorghum where 3-10 rows of groundnut were followed by 1 row of cereal. It was quite common to find more than two crops in the same field. Dosso was the only exception where we found that 66% of the farmers grew groundnut as a sole crop. Spanish varieties are commonly grown in all departments (82%) while the Virginia bunch types constitute the remaining 18%. Crop rotation was practiced by most farmers.

Fertilizer Use

We observed wide variation across departments in the use of fertilizer. Maradi had the largest proportion of farmers applying some kind of fertilizer (58%). In all other departments only between 8 and 14% of the farmers applied fertilizers on groundnut. On the whole, 23% of the farmers applied fertilizer on groundnut in 1988.

Weeding

Weeding was done using a local hoe, called "hilaire". At the time of the survey in Dosso 41%, in Maradi 76%, and in Zinder 86%, of the fields had been weeded. As weeding was done manually, the planted area was restricted.

Harvesting, Storage, and Utilization

Groundnut is harvested by hand and then left to dry in the fields. Pods are then separated from the haulms, collected, placed in bags, and stored in the village. The harvest is usually divided into three parts: the largest part is sold, the second is kept as seed for the next cropping season, and the third is used by the family.

Conclusion

Groundnut remains an important crop in Niger. The Groundnut Improvement Program at ICRISAT Sahelian Center should focus on developing sustainable cultural management systems that would not only improve production but would ensure conservation, soil fertility, optimum water use, reduced incidence of weeds and insects, and optimum land use efficiency.

Groundnut Development in Chad

M.A. Djaya and A. Simon[1]

Groundnut Production

Groundnut has been cultivated in Chad since very early times and since then, its cultivation has continued to expand.

Groundnuts are grown throughout most of the country and rank after millet and sorghum. The area under this crop has stabilized at about 130 000 ha for the whole country.

The Sudanian region is the major groundnut-growing area since it has outlets which allow it to market all of its production.

Although Chad does not have structured agricultural research, it does carry out some research and trials at the seed production center at Gassi on early-maturing varieties and at the Institut de recherches du coton et des textiles exotiques (IRCT), at Bebidjia on late varieties:

Breeding

Work carried out at the Gassi Station is focused on:

- collection, identification, and study of local ecotypes which are, in fact, old varieties introduced and released in the Sahelian region a long time ago, e.g., Am-Djoumal is none other than the variety 29-56-3G.
- introduction of new varieties from institutions specializing in groundnuts such as IRHO and ICRISAT and other countries which have similar climatic patterns to those of Chad i.e., Senegal, Burkina Faso, Niger, United States, India, etc. A study of performance, characteristics, and yield as well as drought and parasite resistance of these varieties has led to a proposal for the release of variety TS32-1.

  Other varieties under on-farm trials are very promising and will probably replace the Rose de Deli and 55-437 which have been widely used for a long time.
- Pedigree breeding in relevant ecologies.

Agronomy Trials

These trials focus on the study of resistance of some varieties to groundnut leaf diseases, such as leaf spot, rust, anthracnose, etc., groundnut/cereal (millet, sorghum) intercropping, and after-effects in crop rotation systems.

---

1. Correspondant national du reseau arachide; Chercheur, Ministere de l'Agriculture, N'Djamena, Chad.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Production of Foundation Seeds

The Gassi Station has drawn up a seed production plan which will enable it to guarantee specific and varietal purity as well as improved germination rate. Individual breeding of the parent lines in the field—with 600 plants in the beginning—followed by laboratory screening to assess biometric features enable 50 to 100 parents to be selected.

Prospects for the Year 2000

Groundnut cultivation will continue to increase, especially in the Sahelian region.

Estimates of areas under cultivation will be about 230 000 to 250 000 ha, divided as follows: 35 000-45 000 ha in the Sahelian region and 180 000-203 000 ha in the Sudanian region. Production will be approximately 250 000 t of pods.

The development of groundnut cultivation is very promising because Chad must diversify its sources of fats. Cotton seed oil and groundnut oil remain the only sources.

Groundnut Research in Togo

Y. Atitso and Y. Agossou[1]

Research work in Togo is undertaken by complementary research services, particularly the Togo Cotton Corporation (SOTOGO), the Notse Rural Development Projects (PDRN), and the National Corporation for the Renewal and Development of Togo Cocoa and Coffee Plantations (SRCC).

Research is focussed on varietal grading and agricultural practices. Trials carried out have a bearing on those subjects which are of most concern to growers:

- **Population Trials.** Trials on population density have shown that 125 000 to 160 000 plants ha^{-1} are suitable for optimum yield.
- **Pre-sowing Seed Treatments.** Experiments on several treatments have not produced any significant results: both treated and untreated seeds gave the same results. However, it would be advisable to treat seeds as a precautionary measure.

  The use of herbicides on groundnuts showed that two products, applied at the pre-emergence stage—Stomp® (pendimethalin 330 g L^{-1}) and Cotodon® (dipropetryn) 240 g L^{-1}—were effective.
- **Intercropping.** Two population densities of groundnut intercropped with maize were studied in a trial. An increase in density above 125 000 plants ha^{-1} did not significantly increase the yield.
- **Collection.** The Agricultural Research Directorate collects all local cultivars.
- **Tilling.** The impact of different methods of preparing the soil such as raking, ridging, and plowing using animal traction is assessed. Results have shown that plots where draft animals were used for plowing, produce a higher yield than others.

1. Responsable, Recherche d'accompagnement; Chercheur, Projet de Developpement Rural de Notse-Notse, Direction de la Recherche Agronomique. B.P. 2318, Lome, Togo.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Grain Legumes and Oilseeds Program in the Gambia

S. Drammeh[1]

The Gambia is located on the western coast of Africa, extending like a finger 487 km into the Republic of Senegal. Stretching across 10 690 km^2, it has a population of approximately 800 000 with a population growth rate of 3.5% per annum and a population density of 65 per km^2. Groundnut cultivation accounts for 50% of the land under cultivation.

Past and Present Research Activities

Groundnut research in the Gambia probably started with the introduction of the cultivar 28-206, an erect cultivar from Senegal.

Research activities on groundnuts have been well documented in annual reports prior to 1980. Most of the work done was on varietal screening. However, trials were also conducted on fungicides, fertilizer (mainly potash), seed dressing, time of sowing and spacing, cropping methods, *Cercospora* leaf spots, and moisture gradients. Most of the results from these trials were either inconlusive or never got to the people they were intended for. A number of national and international variety trials have been conducted since 1980 on time of sowing, groundnut response to fertilizer, leaf spot *(Cercospora* spp) control, seed dressing, sowing depth, stand establishment, and multilocational variety trials. Results are reported in annual reports.

By 1989, the Grain Legumes and Oilseeds Program (GLOP) in collaboration with ICRISAT, had developed its genetic base which it still continues to broaden. Based on research results, the program has succeeded in promoting the variety 73-33 which is now widely grown in the Gambia. Two promising groundnut varieties, Robut 33-1 (Kadri-3) and ICGS(E) 52, are undergoing their second year of screening under farmer-planted and farmer-managed multilocational testing. During the 1989 cropping season, our major focus was on varietal screening.

We planted the ICRISAT Multilocational Advanced Groundnut Variety Trial in which some lines outyielded the local 28-206. The trial arrived late and hence the yield potential of 28-206 was not tested under its optimum condition. However, ICGS 83708 which has the same growth duration as 28-206 outyielded 28-206 in the same trial.

The National Agricultural Research Board (NARB) defined research areas that required attention and groundnut was given top priority. The details of this policy are contained in a paper entitled "Agricultural Research Policy for the Gambia".

---

1. Research Officer, Grain Legumes and Oilseeds Programme, Department of Agricultural Research, Yundum Station, The Gambia.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Based on the recommendations of the GLOP task force, the following activities were approved by the NARB for implementation during the 1990 cropping season :

- multilocational medium- and-late maturing groundnut variety trial to evaluate oil-type varieties of similar growth duration to compare yields, oil content, and pest and disease tolerance.
- multilocational early-maturing groundnut variety trial to evaluate confectionery varieties of similar growth duration (90-100 days) in order to identify high-yielding varieties which conform to producer and consumer preferences.
- modest seed increase using recommended varieties and other promising cultivars.

In addition to the activities of the national program during the 1990-91 cropping season, GLOP is also collaborating with ICRISAT in running other trials, such as, Advanced Groundnut Variety Trials for early- and late-maturing cultivars and trials on yield losses due to foliar and fungal diseases. All the above-mentioned trials have been planted and the data are being collected. Thirteen insect-resistant groundnut lines provided by the Peanut CRSP entomologist at Tifton, Georgia are currently being multiplied in preparation for their future evaluation against millipedes and termites.

Looking Ahead

The Department of Agricultural Research (DAR) established in 1988 works and will continue to work in close collaboration with its sister department, the Department of Agricultural Services to disseminate research results and promote adapted technologies. Most of the research activities of DAR are financially supported by the Gambia Agricultural Research and Diversification (GARD) Project.

ICRISAT Sahelian Center assisted the GLOP in preparing a medium-term research strategy statement for groundnuts. The areas that need special attention are: a) stand establishment, b) foliar fungal diseases, c) collaborative work on the adaptation of advanced groundnut varieties, d) systematic disease survey in the Gambia, e) time of fertilizer application and weed control, f) aflatoxin, and g) food technology and conservation.

Progress towards Better Adaptation of Groundnuts for West African Conditions

J.H. Williams, D.C. Greenberg, B.J. Ndunguru, and U. Hartmond[1]

Introduction

In West Africa, groundnut is exposed to a wide range of environments, and it is clear that different genotypes are needed to maximize production in these different agroecological regions. Inevitably, the limiting factors to groundnut production in western Africa differ with agroecological zone. To improve yield by developing varieties better adapted to these environments, it is first necessary to determine the limitations to productivity, and establish the existence of useable genetic variation in response to this environmental factor. Next one needs to develop methods to easily identify genotype attributes.

Drought Responses and Adaptation to Sahelian Conditions

In the Sahelian region, drought is perceived as a major limiting factor. At ISC, scientists examined the yield determination of some 36 genotypes in 5 water-supply environments. The varieties examined included the major varieties of the region and a range of lines from the international germplasm collection and from ICRISAT breeders in India and southern Africa.

These genotypes were grown in three treatments in the prerainy season with irrigation providing 100%, 50%, and 33% of the evaporative requirements. In the rainy season, two sowing dates were used to expose the plants to differing water deficits during the pod-filling phase.

Averaged across these genotypes, these treatments resulted in different levels of productivity in both total and pod yields. The greatest biomass yields were obtained in the fully watered dry-season control treatment; but pod yields were the highest in the early-sown rainy season control treatment. The effects of the limited water supply on growth are obvious.

The analysis of these yields in terms of the crop growth rate (C) and partitioning (p) of this C to reproductive growth clearly showed that the superior pod yields of the rainy season treatment are due to high partitioning. Partitioning was considerably reduced in the dry-control treatment, even when the crop was fully irrigated.

The regression of these yield-determining parameters for individual varieties against the environmental mean in these treatments was particularly revealing. As the environments were known in terms of their physical characteristics and were very similar in terms of their

1. Principal Physiologist; Former Principal Groundnut Breeder; Principal Agronomist; and Graduate Student, ICRISAT Sahelian Center, B.P. 12404, Niamey, Niger (via Paris).

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

soil/chemical characteristics, we could interpret the stability components in physiological terms. As the intensity of drought increased, the mean C decreased and a variety which has an above-average drought resistance for the parameters that contribute to C is expected to have a positive "a" term for the regression of genotype C on mean C. Thus the stability analysis of the C term has physiological/adaptive significance.

We found that the stability of C for the Sahelian-adapted varieties (such as 55-437 and 796) showed that they are apparently better than average in their ability to maintain C in the face of drought, while other non-adapted lines were not.

When we examined their partitioning responses across the range of environments we found that they differed substantially from the average, but not in all environments. In the two rainy season treatments they were very similar to the average of all genotypes, however, in the dry-season treatment, they were consistently better than average. As the water supply and temperature of these environments are known, we were able to interpret these effects. It was very significant that for the Sahelian-adapted varieties, partitioning was maintained at standard (0.9) rates in the fully irrigated dry-season treatment while the "non-Sahelian" genotypes already showed a major decrease in partitioning. This effect suggests that the general limitation arose from the deleterious effects of high temperature. Thus temperature tolerance is a necessary attribute for adaptation to these environments.

High Atmospheric Humidity Stress

Groundnuts are traditionally grown in the semi-arid regions of the world. Analysis of the response of genotypes in international trials has shown that partitioning usually decreases as the mean atmospheric humidity increases. Since partitioning is a very important determinant of pod yield, this response may impose a limitation to yield potential in the more humid regions. West Africa has a large region with high humidity in the rainy season, where this limitation to yield potential applies.

We studied in Benin, with national scientists the change in genotype partitioning in response to different atmospheric humidity regimes across different agroecological zones. One genotype (MH2) maintained its partitioning and seemed to be a key genotype for enhancing yield potential in breeding programs focused on wetter zones. Presently, the variety MH2 does not fit into these regions for several reasons (season length, disease resistance, etc.) but we should exploit it as a parent in the region's groundnut breeding efforts.

Adaptation to Calcium-Deficient soils

The region's soils are mostly deficient in calcium. Although fertilizer inputs provide a ready cure for the problem, we believe that there is genetic variation that can be exploited, particularly in the light sandy soils of the Sahel. Breeders often place heavy emphasis on selecting bunch types, because these simplify harvesting, but, over the past few years we have examined in a GTZ-funded project the effect of this selection in influencing the Ca nutrition of pods. The hypothesis being tested is that by dispersing the pods though a greater soil volume, the individual pod will have access to more Ca. The analysis of Ca deficiency shows runners have less problems than bunch types.

Groundnut Agronomy in Cote d'Ivoire

A. Amalaman[1]

Groundnuts are widely cultivated in northern Cote d'Ivoire either as a sole crop or intercropped with cereals (maize, millet or sorghum). They have valuable industrial use and are also very important for their other uses, such as, haulms for livestock feed.

The groundnut program was started at IDESSA in 1982, to provide techniques suited to extension for short-term development purposes.

Agronomy Program

The aim of the program is to develop methods that improve traditional cultural practices and are simple and easy to extend. The program is divided into two main areas: experiments and surveys.

Experiments

Experiments on fertilization, sowing density, and tilling are carried out. Results showed that phosphorus was the main nutrient of groundnuts. Spanish-type varieties responded better to higher sowing densities without fertilization. Seed treatment with Thioral increased by 15% the number of plants harvested but had no significant effect on the harvested weight. The variety RMP 91 performed better than the local variety in the northern part of the country. Its superior performance was evident even without fertilization. Tillage gave mediocre results. The positive interaction of plowing with ridging on the emergence rate and the positive effect of ridging on population densities and yield were the only results that were obtained.

Agricultural Surveys

The aim of the surveys is to identify the major constraints that hamper groundnut production on the farm. Results showed that soil changes and late sowing were severe constraints.

1. Assistant de recherche, Institut des Savanes (IDESSA), 01 B.P. 635, Bouake, C6te d'Ivoire.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Groundnut Agronomy in the Central African Republic

O. Osman[1]

Introduction

The Central African Republic has a semi-arid tropical climate. Rainfall ranges from 800 mm to 1600 mm spread over 6 to 7 months, from April to October. It has medium ferrallitic and leached gray ferruginous soils.

Agronomy

Groundnut is traditionally sole-cropped but it is also often intercropped with sorghum. It ranks third after cotton and sorghum in the area under research.

The area under research can be divided into three zones according to rainfall patterns:

- area with up to 1000 mm;
- area with up to 1100 mm;
- area with up to 1200 mm.

Experiments on Sole-Cropped Groundnuts

Three groundnut varieties were tested under on-farm conditions in a Fisher block design to assess pod yields.

Table 1 shows the superior quality of late-maturing variety RMP 15 in all three zones.

Table 1. Comparison of three sole-cropped groundnut varieties.

	Yield (kg ha^{-1})		
Variety	1000 mm	1100 mm	1200 mm
2IE	1546	1216	1710
KH 149A	1522	1120	2119
RMP 15	2416	1340	2724

1. **Responsable, Cultures vivrieres, Societe centrafricaine de developpement, SOCADA, BP 997, Bangui, Central African Republic.**

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Experiments on Groundnut/Sorghum Intercropping Systems

Since RMP 15 performed better than others it was intercropped with sorghum in various sowing patterns (Table 2).

Table 2. Yield (kg ha^{-1}) in various sowing patterns under the groundnut/sorghum intercropping system.

Sowing pattern	Yield (kg ha^{-1})	% of sole-crop yield	No of Plants ha^{-1}	% of sole-crop population
Sole-crop groundnut	2767	100	126 250	100
Groundnut juxtaposed with sorghum	610	22	63 125	50
Groundnut superposed on sorghum	377	13	94 487	75
Sole-crop sorghum	1513	100	55 833	100
Sorghum juxtaposed	1275	84	27 916	50
Sorghum superposed	1503	99	55 833	100

Intercropping groundnuts with sorghum had a negative effect on production. However, groundnut grown in juxtaposition to sorghum performed better than when it was superposed on sorghum.

In another trial, groundnut varieties, 2 IE (90 days) and RMP 15 (120 days), were grown in juxtaposition to sorghum (Table 3).

Table 3. Pod yield (kg ha^{1}) of two groundnut varieties intercropped with sorghum.

	Pod yield (kg ha^{-1})		
Variety	1000 mm	1100 mm	1200 mm
2 IE	820	585	877
RMP	825	550	466

Groundnut yields remained low, irrespective of the variety. The early-maturing variety had a slight advantage over the late variety. This result is contrary to that found in Table 1.

Groundnut Improvement in the Dry Areas of Northern Ghana

K.O. Marfo and M.A. Assibi[1]

Groundnut *(Arachis hypogaea* L) is an important oilseed in Ghana. It is also an essential component of the sustainable agricultural system in northern Ghana as it can fix high amounts of atmospheric nitrogen; moreover, its haulm can be also used as fodder. However, both biotic and abiotic factors are responsible for reducing its yield. While *Cercospora* leaf spots and rust are the major biotic stresses, the abiotic stresses include erratic and limited rainfall. The Groundnut Improvement Program of the Nyankpala Agricultural Experiment Station is mandated to evolve high-yielding and stable genotypes and varieties.

Methodologies

In order to achieve these objectives, the researchers at the Nyankpala Station initially evaluate germplasm from both national and international groundnut programs of research institutes, including ICRISAT. Based on the performance of these lines with respect to their grain and oil yields, disease and insect pest resistance, and biomass production, high performers are advanced to multilocational tests at four sites representing the major ecological zones of the northern region of Ghana. Results obtained in these multilocational tests are then subjected to stability analysis because of the significant genotype x environment effects that are usually encountered. This assists the breeders in recommending the most stable lines to be advanced for further evaluation on farmers' fields before finally adopting them as varieties.

A hybridization and selection program using pedigree backcrossing to reduce the field dormancy levels of our cultivar F mix (a multiline) is far advanced. In F_2, 6 lines showing desirable field dormancy levels in addition to good agronomic traits have been selected. These will be evaluated in preliminary trials at Nyankpala during the 1991 cropping season.

Conclusion

Our program will continue to utilize lines developed by ICRISAT and other national programs as sources of germplasm with desired genes in our breeding program. It is our hope that with the development of stable and high-yielding varieties and adoption of recommended cultural practices, particularly higher population densities (a major agronomic constraint on farmers' fields), the overall national output and utilization of groundnut will increase.

1. Food Legumes Breeder; Breeder, Agricultural Experiment Station, Nyankpala, P.O. Box 52, Tamale, Ghana.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Groundnut Rosette Virus: Recent Progress in Breeding for Resistance in Southern Africa

G. L. Hildebrand[1] and S. N. Nigam[2]

Groundnut rosette virus (GRV), although not widespread every year, induces loss approaching 100% in some years when there is a pandemic outbreak of the disease. It is the most serious groundnut virus disease in southern Africa.

The SADCC/ICRISAT Groundnut Project initiated a breeding program in 1982 to develop agronomically acceptable, GRV-resistant groundnut *(Arachis hypogaea* L.) varieties adapted to the growing conditions of the region. Incorporating resistance into short-duration varieties is one of the major aims of this program.

GRV may be controlled in many ways, one of which is the use of insecticides. But, this is beyond the reach of resource-poor farmers in the semi-arid tropics. Resistance to the vector has been identified in several genotypes and this may afford a useful level of protection. However, genetic resistance to the virus itself is likely to be the most effective method of minimizing yield reductions due to GRV.

Breeding for Resistance

Genetic resistance to GRV is available in cultivated groundnuts but has been demonstrated only in a limited range of germplasm. Most of these are of the alternately-branched Virginia type and are similar in many respects.

Crosses have been made using a number of the available sources of resistance. Few sources of rosette resistance have been reported in sequentially-branching genotypes but we are making extensive use of a recently-purified introduction of KH 241 D from West Africa. Recovery of adapted GRV-resistant Spanish types from crosses involving long-season sources is small because of the combination of two traits both of which have long probability. The use of short-season sources of resistance would improve recovery of suitable resistant genotypes.

F_1 populations from crosses made in 1987/88 and 1988/89 between sequentially-branching varieties which were adapted but susceptible and this genotype were of the same type as the adapted parent. A number of these populations show promise for yield potential.

1. Principal Groundnut Breeder, SADCC/ICRISAT Groundnut Project, P.O. Box 1096, Lilongwe, Malawi.
2. Principal Groundnut Breeder, ICRISAT Center, Patancheru, A.P. 502 324, India.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Screening

We have perfected a technique for screening breeding populations for rosette resistance. Rosette-infected and heavily aphid-infested seedlings grown in greenhouse are transplanted into susceptible spreader rows. Single spreader rows are sown after every pair of test rows, and infector plants are introduced into spreader rows at 1.5 m intervals. We have succeeded in inducing regularly, GRV incidence exceeding 92% in susceptible test entries. Symptomless plants (a mixture of resistant plants and "escapes") are selected and are tested in the nursery the following summer.

Selection

We have delayed entry of segregating populations into the rosette nursery until the F_3 generation, when populations advanced by single-seed descent are entered into the screening nursery. This procedure allows duplicate populations for screening and selection for other attributes. Screening in F_2 results in eliminating all susceptible segregants.

Progress in Breeding

In 1987/88, we selected 12 high-yielding alternately-branching lines from F_5 breeding populations. In 1988/89, these were the first rosette-resistant selections to be entered into replicated yield trials. They were concurrently entered into the rosette nursery and were all confirmed resistant.

Their performance in these trials was very promising and four ICGV-SM—88709, 88710, 88711, and 88734—were selected on the basis of yield, shelling percent, and seed color for inclusion in regional yield trials grown in Malawi, Swaziland, Zambia, and Zimbabwe in 1989/90.

Performance of these varieties at Chitedze, Malawi, compared favorably with those of local controls but their performance in Zambia was inferior to that of local controls. In Zimbabwe, they compared favorably with only one of the local controls. Their seed size was disappointing but three of them have suitable tan seed color.

Nineteen new GRV-resistant virginia-type selections made in 1988/90 were included in a yield trial for the first time in 1989/90. Six of these significantly outyielding RG 1 ($P < 001$), the GRV-resistant control. Most of these have variegated seed color and their seed size is inferior to that of local controls.

Results of Groundnut Breeding in the Central and Northern Regions of Burkina Faso

Z. Bertin, S. Traore, and J. Gautreau[1]

Introduction

In the central and northern regions of Burkina Faso and more specifically in the Sudanian-Sahelian region, drought is caused not only by much shorter rainy seasons, but also by the frequency of more on less long dry spells during the rainy season. The establishment of groundnut varieties which have less than a 90-day growing period is examined in this paper.

Main Results

Very Early Varieties

Research was carried out on 75- to 80-day varieties in order to maintain groundnut cultivation in the central region and to extend it in the north of the country. Among the five varieties which are compared to TS 32-1 in three areas, three stood out as regards their yields per hectare, estimated at 113% to 115% of the control, and maturity rates estimated at 106% to 109% of the control. On the other hand, the seed size is disappointingly small.

Confectionery Groundnuts

The aim of the study on confectionery groundnuts is to create well proportioned large-seed Spanish varieties. On the whole, the varieties under trial produced more pods per hectare than the control variety QH 243C. Yields recorded in the areas under study were very similar to each other, e.g., at Gampela, yields were approximately 1.7 t ha^{-1} and at Saria 2.7 t ha^{-1}. Five out of 7 varieties are on average 20% better than the control variety. The mass of the very densely clustered seeds is slightly low (35 g per 100 seeds; control 37 g per 100 seeds).

Edible Groundnuts

In the edible groundnut category, six varieties of the large-seeded, marketable AHK 87 series are available. The varieties under trail are statistically equivalent to the control CN 94C

1. Attache de recherche; Attache de recherche; Ingenieur Agronome, Institut d'Etudes et de Recherches Agricoles (INERA), 03 B.P. 7192, Ouagadougou, Burkina Faso.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

for yield. Four varieties have larger seed size than the control (123-136% of the control). Yet, they are still below the norms fixed for edible groundnuts and in the present circumstances, it is better to classify the varieties under trial as confectionery groundnuts.

Oil-Type Groundnuts

The oil-type groundnuts include the SH lines of confectionery groundnuts whose grains do not, a priori, comply with the technical criteria of confectionery grades. Their pod yields were similar to those of the control. Two varieties, AHK 87-31 and AHK 87-19, show good seed mass (48.7 and 50.2 g per 100 seeds).

Selection from an SPI Sub-Population

F_3 seeds of the first SPI population, improved through recurring selection for productivity and physiological adaptation to drought were sent by the Institut senegalais de recherches agricoles (ISRA), Senegal, to screen for short duration and yield.

It was found that the very early varieties (75 days) often performed better than the control: with higher pod counts and equal or better maturity rates. The seed size was too small and should be improved.

Edible groundnut varieties gave yields similar to those of the control with acceptable 100-grain mass. The marketable grade confectionery groundnut varieties were clearly superior to the control, with increased pod production of up to 25%. Increasing the size of the seeds should be one of our future goals.

Germplasm of Wild Species of *Arachis:* Evaluation and Utilization[1]

C.E. Simpson[2]

The genus *Arachis* L originated somewhere on the ancient Brazilian shield well before the occurrence of a series of mid-Tertiary uplifts of the shield. After the uplifts, the genus, along with the peneplane, was distributed by downward moving soil and water in the various river valleys of north-central, eastern, and southern Brazil; the eastern half of Bolivia, east of the present Andes ranges; almost all of Paraguay; north-west, north, and eastern Argentina; and west and north Uruguay. As the South American continent continued its westward drift, the Andes continued to be graded upward and eventually lifted the most recently evolved species to elevations several hundred meters higher than their progenitors. This gives a false impression of evolutionary sequence if you think of newer species evolving "downstream" without considering the uplifting action at work on the Cordillera.

The genus *Arachis,* represented by some 70 to 80 species, has been an opportunistic taxon, taking advantage of many diverse habitats; from the Catinga of Northeast Brazil, to the forests of the Amazon, to the swamps of the Gran Pantanal, to the thorn-thickets of the Gran Chaco in Bolivia, Paraguay and Argentina.

The genus can be divided into eight rather distinct taxonomic sections (Table 1).

Table 1. Sections and the number of species in *Arachis.*

Section	Ploidy level	No. of species.
Arachis	2 x & 4 x	34
Erectoides	2x	17
Extranervosae	2x	8
Ambinervosae	2x	4
Triseminalae	2x	1
Caulorhizae	2x	3
Procumbensae	2x	10
Rhizomatosae	2 x & 4 x	3

These sections are genetically well isolated, with very few intersectional crosses being successful. The *Arachis* section is most important to groundnut breeders because it contains

1. **Collaborating Principal Investigator on the Texas A&M University Peanut CRSP "Breeding Peanuts for Semi-Arid Environments", Dr O. D. Smith. Supported in part by USAID Grant No. DAN-4048-G-00-0041-00.**

2. **Professor/Peanut Breeder, Texas Agricultural Experiment Station, P.O. Box 292, Stephenville, Texas, 76401, USA.**

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

the cultivated groundnut and essentially all the species in the *Arachis* section will cross with *Arachis hypogaea,* allowing for gene exchange to occur.

Some of the wild species of *Arachis* have been evaluated for several characters. Included in the evaluations have been: early and late leaf spot, rust, spider mites, nematodes, web blotch, several virus diseases, at least three insect pests, and several agronomic and quality factors. Our current efforts are concentrated on leaf spot, rust, nematodes, *Sclerotinia,* and early maturity. Resistance to many of these plant pests as well as such desirable traits as early maturity have been found in the wild *Arachis* species. We have identified an introgression pathway which utilizes the B genome *A. batizocoi* as a bridge species between the tetraploid cultivated and the diploid wild *Arachis.*

At present, our program for leaf spot control is utilizing late leaf spot resistance from *A. cardenasii* and *A. batizocoi,* and resistance to early leaf spot from *A. chacoensis.* We are utilizing resistance to root-knot nematode *(Meloidogyne arenaria)* found in *A. cardenasii* and *A. batizocoi.* Genes for early maturity are being introgressed from the *Arachis* sp identified as VSGr-6416. These three introgression efforts are in the early stages and will require several more generations of backcrossing and testing before we have agronomically acceptable breeding lines which can be utilized in groundnut breeding programs for cultivar development. However, to this point, our results appear very encouraging and we are optimistic that the programs will be successful.

Groundnut Breeding In Niger: 1987-89 Summary of Results

A. Mounkaila and O. Idi[1]

The aim of the Groundnut Breeding Program, in Niger, is to breed early-maturing and drought-resistant varieties.

Initial crossings have been carried out since 1977. The best varieties were selected through yield trials undertaken at the Tarna Station from 1983 to 1986. These varieties became the core of the program to which there have been yearly additions of the best introductions and selections.

The characteristics of the three years during which trials on the best varieties were conducted are:

- 1987, a year of almost continuous drought and sand storms;
- 1988, a year with good rainfall, but with severe outbreaks of aphids and rosette at the beginning of the flowering period;
- 1989, a year with very good rainfall, but with aphid infestation at the end of the flowering period, and outbreaks of leaf spot during maturation.

Breeding trials were carried out on tested collections vis-a-vis the best controls:

- 55-437, drought-resistant control;
- TS-32-1, productivity control;
- 796, early-maturing control.

The best controls were 796 in 1987 and 1988 and TS 32-1 in 1989. Although the long growing periods given to early-maturing varieties were to their disadvantage (rots, plant remnants in the soil, and aflatoxins), many performed better than the controls. On average, yields in 1987 were 10% and in 1988 19% only of the 1989 yield. But during these first two years, it was found that there was an increase of 32%-33% with respect to variety 55-437. Twenty-one varieties were found superior to 55-437 in 1989. On average, over the three years, 62 varieties performed better than 55-437, by a fairly comfortable margin, up to 30% and with significant differences.

It is interesting to note that the varieties that were selected for early maturity, as recorded throughout the selection period since 1979, and especially in 1984, superseded variety 55-437 in 1987 as they were more drought-resistant. In 1989, they performed better than 55-437, largely due to their higher prductivity level. They were more productive than the control even in 1988, when there was a rosette epidemic. This is all the more important since

1. Selectionneur; Selectionneur, CNRA, Tarna B.P. 240, Maradi, Niger.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

the early varieties appear to have a different form of drought-resistance to that of 55-437. The results obtained in 1987 and 1989 made it possible to identify 26 varieties which were more drought-resistant than 55-437.

Trials on 18 varieties for rosette resistance in 1988 revealed that T1-88 and T5-88, two new KH introductions (149 A and RMP 12), are resistant to the disease.

The selected varieties can give improved yields in drought years while maintaining a high level of productivity in years with good rainfall. T1-88 (KH 149 A) and T5-88 (RMP 12) are rosette-resistant, but they are not drought- resistant. The program will continue to concentrate on improving drought-resistant varieties. It will also work on shortening the growth duration of rosette-resistant varieties.

Research on Groundnut Diseases at the Niaouli Research Station in Benin

O.A. Sanni[1]

The Food Crop Research Station, at Niaouli, is a unit of the Agricultural Research Directorate (DRA). Its aim is to promote research on food crops in the central and southern regions of Benin (Zou, Mono, Atlantique, and Oueme).

ICRISAT-Niaouli Joint Trial on Groundnut Crop Losses Due to Leaf Diseases

The purpose of the trial in 1989 and 1990 was to assess the effectiveness of Corvet CM® fungicide in combating groundnut leaf diseases, notably late leaf spot and rust. Six varieties of groundnut were tested with and without CORVET CM® applications, at the Niaouli station using a split-plot design.

Results

Due to certain technical problems, the results for 1989 were not satisfactory. In 1990, however, the trial began on 20 Apr and the first symptoms of late leaf spot were not observed until after the first fortnight in June.

Magnesium deficiency was, however, found very early on the plants. All varieties, except 55-437 (the earliest to mature), had healthy foliage on the plots which had been treated before harvest. The haulm yield from all varieties on the treated plots, therefore, doubled in contrast to untreated plots.

There were very few cases of rust, especially in 1990 when, on the whole, the disease pressure was hardly more than 5%.

Yields were rather low in 1990, mainly due to the poor quality of the soil where the trials were held, and to rodent attack.

1. Chef, Division Protection phytosanitaire, Station de recherche sur les cultures vivrieres, Niaouli, B.P. 3, Attogon, Benin.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Screening of Some Groundnut Lines for Leaf Spot, Rust, and Rosette Resistance

Green rosette pressure is reported to be the most severe on the groundnut crops in Zou, the central region of Benin. Thirty-six lines were tested at Save and Savalou in this Department, in 1990. Resistance to rosette, leaf spot, and rust was evaluated.

There was more rosette infestation at Savalou than at Save. There was practically no incidence of rust at either site. Varieties ICGV 86091 and ICG 9211, and MOTO were entirely devastated by rosette in Savalou.

About twenty lines showed an acceptable degree of resistance to this disease with 5-10% infestation. Work on screening will continue in future.

Current Status of Research on Groundnut Diseases in Nigeria

O. Alabi, S.M. Misari, S.R. Boye-Goni, and P.E. Olorunju[1]

Groundnut (*Arachis hypogaea* L) is a major food crop and foreign exchange earner in Nigeria. Research on major pests and diseases affecting the crop are carried out as they are serious constraints to its production. This paper reviews and gives the highlights of the research work in Nigeria.

Seedling Diseases and Seed Dressing

Seeds are subject to contamination and attack, and subsequently yield losses, by pathogens such as, *Macrophomina phaseoli, Fusarium* spp, and *Phoma* spp. It was found that the traditional seed dressing chemical (Fernasan D® or Aldrex T®) gave better seed germination than Apron Plus® (metalaxyl + furathiocarb) carbosulfan-thiram based formulations (Marshal ST®), but the latter gave better control of aphids during the first 18 days after sowing. Monitoring and screening of new chemicals to ascertain efficacy, safety, and suitability to the environment are done regularly.

Foliar Diseases

Early leaf spot *(Cercospora arachidicola* Hori) and late leaf spot *(Phaeisariopsis personata* (Berk and Curt) V Arx.) and rust *(Puccinia arachidis* Speg.) are found to be serious diseases and most varieties are susceptible to them. Cultural control measures that are currently being used need to be supplemented with the use of inexpensive fungicides which can be bought by farmers.

Leaf spot attack results in yield loss of up to 50% or more annually. Dithane-M-45® (Zinc manganese ethylene bisdithiocarbonate) was recommended to be applied at the rate of 2 kg ha^{-1} in 300 L of water: first spray at 3 weeks after sowing, followed by 9 more applications at weekly intervals.

Rust *(Puccinia arachidis* Speg.) first appeared in Nigeria in Oct 1976 and later became widespread. Fungicide control trials and breeding for resistance to the disease are in progress. From studies carried out so far, it appears that newer chemicals, carbendazim, tridemorph + maneb or tridemorph + MBC + maneb, have systemic activity and require only 4-5

1. Lecturer/Researcher; Deputy Director; Breeder; Breeder/Virologist, IAR, Ahmadu Bello University, PMB 1044, Samaru, Zaria, Nigeria.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

applications per season as opposed to 8-10 applications with mancozeb. Promising varieties that are simultaneously resistant to all these foliar diseases have been identified in the Institute for Agricultural Research (IAR), Samaru and these are being evaluated.

Groundnut Rosette

Groundnut Rosette Virus Disease (GRVD) has been present in Nigeria for several decades but the worst epidemic of the disease in which severe losses were recorded was in 1975. Since then, research on GRVD, including collaborative research with international bodies have intensified. From results obtained, it appears that Marshal 25®/STD/thiram seed dressing and granular Furadan 3G® applied to soil enhanced seedling emergence/establishment and aphid/rosette control during the first 2 weeks. Cultural measures also help in rosette control. Three of the six new varieties released by recently IAR, are resistant to groundnut rosette. Other reported virus and virus-like diseases include 'little leaf' disease, cowpea mild mottle virus disease (CMMV) and tomato spotted wilt virus (TSWV). There is need for work on the incidence and significance of these diseases.

Aflatoxin and Multiple Disease Resistance

Commercially grown groundnuts are not resistant to *Aspergillus flavus* and aflatoxin contamination of seeds. Research has shown that early harvesting of mature pods controls A *flavus.* In addition, broken, damaged rotten pods and moldy seeds should be discarded. Rosette epidemics are sporadic but devastating and may also occur together with the three foliar diseases. Sole dependence on pesticides to control foliar diseases and the aphid vector of rosette does not appear to be practical for the small-scale farmer. Breeding work in IAR, has, therefore, been focused on producing multiple disease-resistant varieties.

Nematodes

It is reported that about 16 parasitic nematode genera are associated with the roots of groundnut crop. FURADAN 3G® and MOCAP 10G® at high levels significantly reduced nematode populations.

Conclusion

In view of the importance of groundnut and threats to its production by diseases, it is necessary to continue research on groundnut diseases, including their epidemiology in order to forecast their outbreaks for effective control with minimal use of pesticides. Efforts should be intensified to develop resistant varieties that are adaptable to the diverse ecological zones where groundnuts are grown in Nigeria. Meanwhile farmers are being encouraged to adopt recommended production packages including the use of recommended varieties, seed dressing, and timely sowing at high plant density.

Evaluation of Yield Losses Due to Groundnut Leaf Diseases in West Africa

F. Waliyar[1]

The most prevalent leaf diseases in West Africa are early leaf spot *(Cercospora arachidicola),* late leaf spot *(Phaeoisariopsis personata),* and rust *(Puccinia arachidis).* However, the severity of outbreaks varies according to the climatic conditions in the different agroecological zones. When these diseases combine they can cause up to 70% yield loss; alone they cause up to 50% loss. During the 1989 rainy season, we carried out a multilocational trial in order to estimate yield losses due to groundnut leaf diseases. The trials were conducted on two sites in Benin, the Ina and Niaouli Research Stations, in collaboration with the Direction de la recherche agricole (DRA) on one site in Burkina Faso, near Bobo-Dioulasso, in cooperation with Institut national d'etudes et de recerches agricoles (INERA) and Institut de recherches pour les huiles et oleagineux (IRHO), and on three sites in Niger—Bengou, Maradi and Sadore, in collaboration with Institut national de recherches agronomiques du Niger (INRAN). We used six varieties of groundnuts: three regional and three ICRISAT varieties of which two were resistant to leaf diseases. In part of the trial we applied Corvet CM® (carbendazim, mancozeb) in doses of 1.5-2kg in 500 L of water ha^{1} according to the severity of the disease.

Development of Leaf Diseases

Early and late leaf spot were present in all three countries but not to any great extent in Maradi and Sadore. Early leaf spot appeared about 40 days after planting. From the 60th day until harvesting, late leaf spot was predominant. Leaf surface damage was about 90 to 99% depending on the variety and the site.

The presence of rust was recorded in Benin and Burkina Faso. It was more severe at the Niaouli station than at Ina, particularly towards the end of the cropping season. It was extremely severe thoughout the season in Burkina Faso. Two improved varieties from the ICRISAT, breeding program in India, maintained a very high level of rust resistance in Burkina Faso.

Pod Yield

All varieties produced higher pod yields with fungicide treatment. At Bengou, varieties 28-20 produced 2.4 t ha^{-1}; 55-437, 2.7 t ha^{-1}; and 47-16, 2.6 t ha^{-1} with fungicide treatment. Without

1. Principal Groundnut Pathologist, ICRISAT Sahelian Center, B.P. 12404, Niamey, Niger.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

treatment, 28-206 produced 1.3 t ha^{-1} (45% yield loss); 55-437, 1.6 t ha^{-1} (40% yield loss); and 47-16,1.3 t ha^{-1} (50% yield loss). Variety ICGMS 55 only lost 5.7% of its yield.

The highest yields were recorded at the Ina station, Benin. Varieties ICGS 11 produced 4.8 t ha^{-1}; 28-206, 4.4 t ha^{-1}; and ICG (FDRS) 10 4.3 t ha^{-1} with fungicide treatment. Without treatment, ICGS II produced 2.9 t ha^{-1} (39% yield loss); 28-206, 2.9 t ha^{-1} (35% yield loss), and ICG (FDRS) 10, 3.4 t ha^{-1} (21% yield loss). The two leaf disease-resistant varieties had lower losses than the rest, with or without the application of fungicide.

The highest yield losses were seen in Burkina Faso. The yield for the variety 47-16 was 2.9 t ha^{-1} with treatment and 1.3 t ha^{-1} without. The 56% loss show that leaf diseases are prevalent in Burkina Faso where all three diseases are severe. Resistant varieties had relatively slight losses: 29% for ICG (FDRS) 70 and 14% for ICG (FDRS) 2. Variety ICGS 11, whether treated or not, was the most productive on all sites.

Groundnut Leaf Disease Control in Burkina Faso

J.P. Bosc and A. Minoungou[1]

In Burkina Faso, the spread of leaf diseases is closely linked to climatic zones. In areas where rainfall is less than 900 mm, early leaf spot *(Cercospora arachidicola* Hori) predominates. Late leaf spot *(Phaeoisariopsis personata)* and rust *(Puccinia arachidis* Speg.) are negligible in these regions, but increase in severity with higher rainfall and are a major problem in areas with rainfall regimes over 1000 mm, i.e mainly in the south-western part of the country. In this region, there are also outbreaks of rosette of variable intensity from year to year.

Studies on control of these pathogens concentrated on the Niangoloko region, which borders on Cote d'Ivoire. The varieties which are presently released in the area were developed through a breeding program for rosette resistance, and have been available for about 15 years to farmers. These varieties are very productive and cover the three growing periods which suit the area: RMP 12 and RMP 91, virginia-type with long growing periods (150 days); 59-426 and 69-101, virginia-type with medium growing periods (120 days); and QH 243 C and KH 149 A, spanish-type with a short growing period (90 days). RMP 12 and RMP 91 show partial resistance to late leaf spot. This resistance level although low appears to be adequate to control the disease.

The damage caused by these three pathogens is shown when the foliage of the plant is monitored. The combined effect of rust and early leaf spot or rust and late leaf spot on RMP 12 leads to severe defoliation from the mid-growing period onwards. Yield losses are about 40% in the variety RMP 12 (due to both rust and leaf spot equally). The loss is about the same for the variety 59-426. QH 243 C seems more tolerant and showed only 20% loss in 1989.

Research on groundnut leaf disease control aims to improve cultivar and develop cropping practices that will lessen the effects of these diseases as well as the use of chemical control to protect these varieties.

1. Phytopathologiste; Attache de recherche, Institut d'etudes et de recherches agricoles (INERA), B.P. 7192, Ouagadougou 03, Burkina Faso.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Importance and Distribution of the Major Groundnut Diseases in Mali

M. Diourte and D. Soumano[1]

Groundnut, both as a food and export crop, has occupied an important place in Mali's agricultural economy for several decades. There were fluctuations in the total production area during the seventies and eighties because of several limiting factors. Nearly all the country's farmers grow groundnuts, using different techniques on different farm sizes. Some 160 000 ha, i.e., nearly 6% of Mali's areas under cultivation are planted to groundnut.

Groundnut Diseases

Leaf Diseases

The main leaf diseases that attack the above-ground parts of groundnut plants, are early leaf spot *(Cercospora arachidicola* Hori), late leaf spot *(Phaeoisariopsis personata),* and rust *(Puccinia arachidis* Speg.). These fungal diseases are by far the most important and appear regularly in nearly all the different ecologies where the plant is grown.

Chemical control trials to protect groundnuts from leaf spots led to the recommendation of some products are appropriate for extension and which have controlled the severity of the disease. Nevertheless, problems have been encountered in the use of these fungicides by farmers.

Rosette

Rosette is less prevalent in Mali. There are cases of green rosette, a viral disease transmitted by the aphid *Aphis craccivora.*

Diseases of the Underground Parts of the Plant

The most frequently observed diseases of the underground parts of the groundnut plant are root rots and pod rots caused by *Macrophomina* spp and *Pythium* spp.

1. Phytopathologiste; Selectionneur and Chef du Programme d'amelioration de l'arachide, IER/DRA/SRCVO, Sotuba, B.P. 438, Bamako, Mali.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Collar rot *(Aspergillus niger)* and seedling blight are frequently observed in the sandy soils of Seno at Kaporokeniepe and at Cinzana. Where farmers do not use fungicides on their fields, the death rate of seedlings is so high with spanish-type early-maturing varieties such as 47-10 and 55-437, that resowing is almost always necessary.

Damage caused by *Sclerotium rolfsii, Pythium* spp, etc. has also been seen on farmer's plots.

Aflatoxins

Deterioration in the quality of groundnuts after contamination by *Aspergillus* spp, and production of toxins are a well-recorded problem wherever groundnuts are produced. This phenomenon is observed from harvesting and persists during storage. The degree of contamination varies according to prevailing conditions at harvest.

Future Research Needs

It is possible to improve the groundnut crop by breeding productive varieties that adapt well to diverse agroecological conditions and are resistant to various production constraints, such as diseases:

- Screening available germplasm for resistance to or tolerance of the major diseases (rust and leaf spot).
- Survey of nematodes and soil-borne fungal diseases that damage pods and roots.
- Screening genotypes for resistance to penetration by *Aspergillus* spp, which has already begun at the Laboratory of the Zootechnical Research Center, Sotuba, should continue. All available lines and varieties should be screened in order to identify resistance sources.

Analysis of the Relation between Potential and Actual Groundnut Yields, and Leaf Diseases

S. Savary[1]

In West Africa, groundnut production conditions vary widely. The crop is exposed to a wide range of diseases of which fungal leaf diseases, often play a predominant role in reducing yield.

This paper aims to provide some information on methods used and results of analysis of the relation between potential yields, disease pressure, and actual groundnut yields. Some features of intensive cropping and two leaf diseases—groundnut rust *(Puccinia arachidis)* and groundnut leaf spot (mainly *Phaeoisariopsis personata)*—were chosen for the purposes of the study. The two diseases wreak quite different damage on the crop.

The results of an experiment carried out at Ferkessedougou in the northern region of Cote d'Ivoire, show that there is a significant interaction between intensive cropping and fungal disease pressure, i.e., crop losses caused by foliar diseases increase with the level of crop intensification.

A second experiment was carried out at IIRSDA at Adiopodoume, in the southern part of Cote d'Ivoire following a double strip-plot design. The experiment studied the relation between two factors of intensification: potential yield of the variety and weed control with different severity levels of rust and leaf spot. These significant interactions revealed new information: (1) rust reduces yield markedly when the potential yield of the variety or when weed control is high, and (2) the combined incidence of the two diseases even at high pressures, causes lower crop losses than the sum of losses caused separately by these two diseases.

These experiments show that potential yields (Ya), which take into account production conditions, actual yields (Y), and disease stress (rust (R) and leaf spot (S) pressures), are interdependant. It is possible to imagine actual yield as a response to variations in potential yields and disease stress. This response level may be represented by the equation $Y = f$ (Ya, R, S). This type of relation was made by using a database on a series of basic experiments conducted during 6 successive growing periods with a group of 90 basic plots.

1. Chercheur, Department of Phytopathology, Wageningen Agricultural University, P.O. Box 8025, 6700 EE, Wageningen, Netherlands.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Nematode Damage to Groundnuts and Rotation Crops in the West African Sahel

P. Baujard and B. Martiny[1]

In the Sahelian region of West Africa, about 30 species of plant nematodes have been identified in the groundnut rhizosphere in rotation crop systems (millet, cowpea, sorghum). Field studies on the effect of nematocide in Sahelian crops have shown that the increase in groundnut yields cannot be solely due to the destruction of nematodes. Recently, the stimulating effect of dibromochloropropane on groundnut and cowpea plants has been demonstrated.

It is important, therefore, to obtain more precise data on the pathogenicity of the different species of nematodes found in the rhizospheres of plants grown in the Sahelian region of Senegal in order to use data that emerge from nematological analyses.

Current Findings

Factors Influencing Nematode Multiplication

In a study on the nematode *Scutellonema cavenessi,* it was found that soil temperatures, and moisture content, the host plant in which the nematode lived its preceding cycle, the state of the nematode (active versus anhydrobiotic), the duration of the anhydrobiotic life cycle, and the duration of the preceding cycle have significant bearing on the multiplication rate of this species. Laboratory findings confirmed the data obtained in the field.

The first pathogenic tests carried out on different crops show that these parameters also appear to determine the extent of damage caused by the nematode.

Biotic and Abiotic Factors Affecting the Biology of the Nematode

In the Sahelian region of West Africa, the biotic and abiotic factors that affect the nematode biology are:

- **Temperature.** Most species prefer temperatures of 34°C. Some species, particularly *Pratylenchus* and *Dorylaimid* plant parasites multiply better at temperatures of 30-32°C. Only one species, *Scutellonema clathricaudatum* identified in the eastern region of Mali prefers high temperatures of around 36°C.

1. Charge des recherches; Technician (nematologie), ORSTOM, Laboratoire de Nematologie, B.P. 1386, Dakar, Senegal.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

- **Soil Moisture Content.** The multiplication rate of nematodes increase with the increase in the moisture content of the soil. The only exception is *S. clathricaudatum* which reproduces better in soils with low moisture contents.
- **Plant Host.** Sorghum is a good host for all the species in the area. Millet and cowpea also serve as hosts and favor nematode growth. Groundnut does appear to be a host for most of the species in the Sahelian region. So far we have been able to identify only two species that can multiply on this crop: *Aphasmatylenchus straturatus* and *Scutellonema cavenessi.*
- **Ability to Enter into Anhydrobiotic State.** Apart from the *Dorylaimide* parasites, all the other nematodes in the Sahelian region of West Africa are able to endure dehydration in the soil after the dry season. The *Dorylaimide* species are always located deep down in the soil (more than 60 cm deep) in the telluric strata where the absolute moisture level is always higher than 1% during the dry season.

Effect of Nematodes on Groundnuts in the West African Sahel

Currently, three species belonging to the *Belonolaimidae* family have been studied: *Tylenchorhynchus gladiolatus, T. germanis,* and *T. ventralis.* These species are widespread in the Senegalese Sahelian region right up to the Mali border.

Only the last two species are harmful to groundnuts, as they bring about a massive change in the root system which blocks the water uptake of the plant. Interestingly, these two nematodes do not multiply in the rhizosphere of groundnuts.

Conclusions and Recommendations

Identifying the potential harmful effect of plant nematodes on the rhizospheres of crops in the Sahelian region seems complex; first, the factors which allow these species to multiply, have to be studied, taking into consideration the biological state of the nematodes.

Identifying the pathogenicity of these species would help in interpreting the results obtained by using nematocides or other types of pest control.

As these species of nematodes can be reared under laboratory conditions, the breeder can quickly test the presence of potential resistance in the plant material.

It is necessary to identify nematodes by undertaking an exhaustive survey of the soils of the Sahelian region.

Groundnut Seed Resistance to High Temperatures

Y. Jacob and P. Baujard[1]

A preliminary study was carried out to evaluate the effect of high temperatures on the germination performance of groundnuts in an effort to develop a technique to eradicate virus in groundnut seeds.

Findings show that groundnuts can endure of 60°C-70°C for 20 minutes, 78.5° C for 10 minutes and 80°C-90°C for 5 minutes without losing their capacity to germinate.

Groundnut seeds therefore, can endure high temperatures. A study of the behavior of viruses present in the seeds at such high temperatures should provide information on the usefulness of this method to disinfect groundnut seeds.

1. Graduate Student; Charge des recherches, ORSTOM, Laboratoire de Nematologie, B.P. 1386, Dakar, Senegal.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Groundnut Stimulation by Dibromochloropropane (DBCP), a Fumigant Nematocide

P. Baujard, B. Martiny, Y. Jacob, and R. Ferret[1]

Studies undertaken in Senegal of bromine fumigant nematocides, have shown that the increase in groundnut yields after application of the nematocide, cannot be solely due to the destruction of the plant nematodes.

More recently, it was found that cowpea *(Vigna unguiculata)* growth was stimulated by treatment with dibromochloropropane (DBCP), the most widely used nematocide in the Sahelian region of Senegal.

Study of the effects of DBCP on groundnuts in sterile soil and in a gel medium shows that (1) DBCP stimulates growth in groundnuts; (2) the intensity of this stimulation depends on the injected dose; (3) the stimulation depends on the type of soil although it is not possible as yet to pinpoint the telluric factor that governs this stimulation.

Groundnut growth stimulated by treatment with DBCP results in a significant increase (1) in the length of the above-ground parts; (2) in the fresh and dry weights of the roots and pods; (3) in the number of pods.

It is therefore recommended that an in-depth study be made of the results obtained from the use of nematocides in the field. It is also important to study the determining factor of this stimulating effect on groundnut and cowpea crops in the Sahelian region of West Africa.

1. Charge des recherches; Technicien (nematologie); Graduate Student; Chercheur, ORSTOM, Laboratoire de Nematologie, B.P. 1386, Dakar, Senegal.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Studies on Nutritional and Functional Characteristics of Groundnut-Sorghum Composite Flour

Bharat Singh, Umaid Singh, T. Koleosho, and S. Ogutu[1]

The major objective of the Peanut CRSP Food Technology project is to optimize the utilization of groundnut as food in the semi-arid tropics of Africa. To achieve this goal, it is important to evaluate the quality of groundnut and groundnut products. In this paper, data from studies conducted at Alabama A&M University on nutritional and functional characteristics of groundnut and groundnut-fortified sorghum flour are presented.

Research Results

Effect of Variety on Nutrient Composition of Groundnuts

The oil content of groundnuts is one of the important consideration for selection of a cultivar. However, in recent years, it has been proven that among grain legumes, groundnut is an excellent source of protein for human nutrition. Therefore, groundnut protein yield per hectare should be considered as important as oil. The data from the analysis conducted on lines grown at various locations in Texas indicated variations in contents of protein, oil, fatty acids, and ratios of polyunsaturated to saturated fatty acids, and oleic and linoleic acids.

Nine varieties of groundnuts grown at one location were selected to study the effects of variety on phytic acid, total phosphorus, nitrogen solubility and in vitro protein digestibility. Phytic acid is widely distributed in nature and present in almost all the seeds used for human nutrition. When consumed in excess, it can become an anti-nutrient. In humans, there is a major concern about the bio-availability of minerals such as zinc, calcium, and iron which are not readily absorbed when insolubilized as calcium phytate. Nitrogen solubility, and in vitro

1. Professor; Visiting Scientist (Biochemist, ICRISAT Center, Patancheru, Andhra Pradesh 502 324, India); Graduate Student; and Research Assistant, Alabama A&M University, Department of Food Science, P.O. Box 274, Normal, AL, 35762, USA.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

protein digestibility are considered important for nutrition. The data from analyses indicated considerable variations in these parameters. The phytic acid content ranged between 2.89 mg g^{-1}, for TP 178-3 and 3.96 mg g^{-1}, for TP 172-2. Phytic acid constituent ranged from 61.2% to 76% of the total phosphorus.

Nitrogen solubility ranged between 49.7% and 60.5% and in vitro protein digestibility between 66.8% and 77.5% with a mean of being 70.9%. The highest protein digestibility was observed in TP 178-3 which contained the lowest amount of phytic acid. There was a negative and significant correlation—although the magnitude of correlation was low—between phytic acid and protein digestibility. Apparently, phytic acid interfered with protein digestibility.

Effects of Processing Methods

Effects of boiling, water blanching, roasting, decortication and grinding on protein, phytic acid, nitrogen solubility and in vitro protein digestibility were determined by testing the variety Florunner. Boiling resulted in considerable reduction in phytic acid. The lowest amount of phytic acid was reduced due to roasting. The boiling of groundnuts did not change the nitrogen solubility, but it improved the in vitro protein digestibility.

Effects of Groundnut Flour on Sensory Quality and Nutritional Quality of Sorghum-Based Food Products

To improve the nutritional quality of cereal-based traditional diets in the semi-arid tropics of Africa, the use of groundnut flour as a protein supplement has often been suggested. Supplementation of sorghum flour with groundnut flour produced acceptable food product such as kisra, a staple food in Sudan. We evaluated the effects of fortification of sorghum flour to prepare *to,* a staple food in most parts of West Africa. Our objectives in this study were to develop a composite flour which may be used in a variety of cereal-based foods.

The data from sensory characteristics such as color, texture, taste, and general acceptability using a panel of nine members consisting of African students familiar with this food, indicated that acceptable *to* can be prepared using groundnut flour up to a level of 30%. However, sensory score on color, texture, and taste of sorghum *to* improved when 10% groundnut flour was added. Further addition of groundnut flour decreased the sensory score. Higher level of supplementation showed marginal effect on color of the product, whereas texture and taste values decreased considerably. There was a significant increase in the amount of protein of to in the composite flour. In addition to increases in protein, supplementation of sorghum with groundnut flour resulted in increases in lysine and in vitro protein digestibility and decreases in leucine/lysine and leucine/isoleucine ratios. A high leucine/isoleucine ratio in sorghum has been reported to be responsible for the pellagra disease in the sorghum-eating population.

Functional Properties of Sorghum-Groundnut Composite Flour

Raw and heat processed flours of groundnut, sorghum, and their combinations were studied for water and oil absorption, viscosity, gelation, and dispersibility index. There were significant differences in the functional properties of the flours of groundnut, sorghum and their composites (80% sorghum flour and 20% groundnut flour). Water and oil absorption increased due to heat processing and effect was more pronounced in groundnut than in sorghum flour. Addition of groundnut reduced the viscosity peak of sorghum flour. Heat processing reduced nitrogen solubility index and emulsion capacity of the flours of groundnut and sorghum-groundnut composites. Nitrogen solubility index and emulsion capacity of sorghum flour were considerably improved by adding groundnut. The implication of these results will be realized in designing protein-enriched products, based on sorghum flour especially for sorghum-growing regions of the world.

Ongoing Research

Extruded products using sorghum-groundnut and maize-groundnut combinations; shelf-life of composite flours and products for various environmental conditions; and packaging materials suitable for West African conditions, are under study.

Evaluation of the Quality of Groundnut and Groundnut Products in Burkina Faso[1]

A. S. Traore[2] and Bharat Singh[3]

Burkina Faso exports less than 10% of its production of groundnut. All its production is locally consumed in various forms: raw roasted or boiled, non defatted or defatted pastes, and other products containing groundnut. These products are sold in cities and in villages. So far no research has been done on their nutritional quality. The present paper aims: (1) to give an overview of some groundnut based products found in Burkina Faso; (2) to determine their nutrients; (3) and to study their microbial and aflatoxin contamination.

Studies were conducted to evaluate quality of groundnut and groundnut products in Burkina Faso. Studies included evaluation of groundnut cultivars commonly available in this country as well as the lines obtained from Texas A&M University for field testing for drought tolerance and disease resistance.

Results indicated significant variation in proteins, fats, carbohydrates, free fatty acids, and vitamin C. The amount of proteins varied from 14% to 29.5% for local lines and from 16.43% to 22.8% for lines from Texas A&M. Fats varied from 46% to 49% for local lines and from 43.27% to 45.25% for Texas A&M lines. Local lines had wider variations in amounts of protein and oil contents compared to the lines from Texas A&M. In general, lines from Texas A&M had lower amounts of proteins and fat compared to local lines. Aflatoxin was detected in almost all samples, however, the amount was less than 20 ppb.

Groundnut products comprising of roasted, partially defatted groundnut paste and whole groundnut pastes were collected from the markets in the country. The amount of nutrients and free fatty acids varied according to location, time of sampling, and methods of preparation. The paste was evaluated for aflatoxins as well as for microbial contaminations. Groundnut pastes prepared by traditional methods had more aflatoxins than those prepared by industrial methods by a local company. The trend was the same for microbial contaminations.

1. This research was supported by Peanut CRSP Grant No. DANS-4048-G-SS-2065-00.
2. Directeur, INSN-IDR, Departement de Biochimie, Universite de Ouagadougou, 03 B.P. 7131, Ouagadougou, Burkina Faso.
3. Professor, Peanut CRSP, Alabama A&M University, Department of Food Science, P.O. Box 274, Normal, AL, 35762, USA.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Groundnut Research at the Foulaya Agricultural Research Station in Guinea

N.B. Tounkara[1]

Although groundnuts are grown by nearly all farming families in Guinea, domestic demand is not met because of poor yields (500-700 kg ha^{-1}). Poor yields stem from inappropriate cultural practices and the lack of improved varieties. In order to find a solution to these two problems, the Guinean groundnut program opted for applied research after learning from the expertise of more experienced neighboring countries and from results obtained by regional and international institutions.

Germplasm Collection

In 1988, 96 samples were collected from 48 sites in the principal groundnut-growing areas of the country. Some of these samples were retained by ICRISAT for analysis and conservation and the rest were kept at the Foulaya Agricultural Research Station (CRAF) for identification in the field and short-term conservation. In 1989, the collection was increased by the addition of 153 samples from the International Board for Plant Genetic Resources (IPBGR).

Survey of Groundnut Diseases

A collection mission to survey diseases was carried out in 1989 in collaboration with the ICRISAT Sahelian Center. During the exercise, nearly all groundnut diseases were found (seedling blight, leaf spot, rust, fusarium diseases, rosette, clump etc.). In different areas, leaf spot and rust predominated. Seedling blight, clump, and cases of *Aspergillus flavus* were observed in all areas visited by the collection mission. It was established that diseases are the principal limiting factors hampering groundnut cultivation in Guinea.

1. Phytopathologiste, Chef, Filieres Legumineuses alimentaires, Centre de recherche agronomique de Foulaya (CRAF), B.P. 156, Kindia, Guinea.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Varietal Assessment of Crops Sown in 1988 and 1989

Evaluation for Early Maturity

In the screening trials on early-maturing varieties, four lines, ICGV 86053, ICGV 86016, ICGV 86103, and ICGV 86117 were retained out of the 24 breeding lines of early-maturing varieties from ICRISAT, as they were stable and high-yielding.

Evaluation for Confectionery Groundnut

In the screening trials on confectionery groundnut, four varieties, ICGV 82028, ICGV 86504, ICGV 87151, and ICGV 86556 were retained, out of 23 varieties for their sweet taste and their seed size.

Assessment for Resistance to Leaf Diseases

Of the 35 varieties assessed during crop years 1988 and 1989, ICGV 87165, ICGV 87175, ICGV 87176 were found to be resistant to late leaf spot, rust, and tolerant of early leaf spot. These varieties also had better yields and hulling rates than the control.

Determination of Optimum Sowing Densities and Dose of NPK

Determining Optimum Sowing Densities. A local spanish-type variety called "Maressi" was used. A density of 166 000 plants ha^{-1} gave the best pod yield (3.17 t ha^{-1}).

Determining the Optimum Dose of NPK. Trials were also conducted to determine the optimum dose of NPK for groundnut crops.

In conclusion, since the program was carried out in conjunction with eminent researchers from other African countries and international institutions, some steps could be omitted in the research in order to get straight to the adaptation trials.

Some Aspects of Groundnut Production and Research in Congo

N. Ndilou[1]

In Congo, the tradition of groundnut cultivation is very old. Groundnuts are grown in all the ecological regions of the country. They are often intercropped with other crops (cassava, cowpea, and pigeonpea). But, groundnut production is of much concern now, because its exports ceased 25 years ago and local production no longer meets domestic demand which is now at 16 000 t for consumption of grains and 18 000 t for oil production. About 34 000 ha of arable land are under groundnut cultivation from which farmers produce up to 24 000 t of unshelled groundnuts, i.e., an average national yield of 700 kg ha^{-1}. Officially marketed production does not exceed 16% of the total production. At present, groundnuts are mainly produced for farm consumption.

Groundnut-Growing Areas

In Congo, there are three large areas with different ecological systems. The north-eastern, zone is a forest land with rainfall of over 1600 mm, except in the period between December and February when rainfall is low. Most of this area is flooded. Groundnuts are grown on dry land in the forests. The central zone has a transitional sub-equatorial climate. Here, growing two crops is possible by using short-duration varieties. In the south-western part, groundnuts are grown intensively. There are two to three crops of groundnuts a year (the third under irrigation). Annual rainfall is 1200 mm to 1500 mm.

Production Constraints

The major factors which limit production are : low productivity of the plants, low prices and lack of a structure to train farmers. Low yields are due to weeds which are difficult to control, rosette and leaf spots, damage caused by the groundnut bruchid *Caryedon serratus,* and low varietal productivity.

1. Selectionneur, Centre de recherche agronomique, B.P. 28 Loudima, Congo.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Research Activities

Research on groundnut is undertaken at the central Research Station at Loudima. Present activities are centered on germplasm collections, conduct of trials on groundnut bruchids, and varietal improvement. Local and introduced cultivars are collected and tested to find out their potential.

Future Program

Future research work will be based on multilocational trials in order to identify appropriate varieties. More on-farm varietal trials will be carried out. In the long term, a vast hybridization and breeding program could be envisaged. This program will concentrate on the breeding of early-maturing and disease-resistant lines. The program will also focus on yield, oil content, and varietal adaptability for extension. The groundnut network will be reinvigorated by more staffing, funds, and equipment. A better synchronization of research structures, seed multiplication, and increasing extension will boost production and enable our varieties to be adequately disseminated.

The Peanut CRSP in West Africa

D.G. Cummins[1]

The Peanut Collaborative Research Support Program (CRSP) is supported by Grant DAN-4048-G-00-0041-00 from the United States Agency for International Development. The program is managed by the University of Georgia. Participating institutions in the United States are Alabama A&M University, the University of Georgia, North Carolina State University, and Texas A&M University, which collaborate with institutions in West Africa, Southeast Asia, and the Caribbean.

The goals of the Peanut CRSP are to enhance the research capability of both developing countries and the United States and focus this capability to alleviate major constraints that limit sustainable groundnut production and food delivery in an environmentally sound system. The Peanut CRSP enhances the potential of groundnut as a crop for human food and animal feed in host countries and the United States, while contributing to the increase of rural incomes.

The CRSP concept requires that the subjects addressed have a global impact. Groundnut fits into this global concept as a result of the worldwide distribution of the crop, its importance in both developing and developed countries, marked similarity of production and utilization constraints worldwide. Among the other important factors are the potential for research to relieve its production and utilization constraints and enable it to contribute to an increased food supply in countries where total food and protein supply is marginal. The synergistic effect of international cooperation among groups such as ICRISAT and IRHO in groundnut research also add to its global scope. The Peanut CRSP is active in three major world regions—West Africa, Southeast Asia, and the Caribbean—based on constraints to groundnut production and utilization in those regions. Research conducted by Peanut CRSP has impact also on the United States producer and consumer.

West Africa

The Peanut CRSP is concentrating its Africa program on the Sahelian Region of West Africa. The Region has severe constraints to crop production dominated by a short rainy season that is broken by intermittent periods of drought. The drought problems are compounded by disease and insect pressures, and aflatoxin contamination. These constraints and problems make sustainable production difficult, which in turn creates problems in maintaining a sustaihable and adequate supply of food for a growing population.

Constraints to production and food delivery in West Africa that have been identified for study under the collaborative mode of the Peanut CRSP are: low yields because cultivars

1. Program Director, Peanut CRSP, University of Georgia, Griffin, GA 30 223-1797, USA.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

are not adapted to the short rainy seasons and lack resistance to diseases, insects, and droughts; yield losses due to infestation of weeds, insects, diseases, and nematodes; mycotoxin hazards to health due to fungal invasion of the groundnut; inadequate food supplies and lack of appropriate food technologies to exploit a relatively well adapted crop that is not generally considered a primary source of food; and resource management (agronomic, economic, and sociological) situations preventing efficient production and utilization.

Countries, Institutions, and Research Programs in West Africa

Senegal. Research is under way to develop cultivars that are disease and stress resistant and adapted to the short season environment. Management of aflatoxin through breeding for resistance, detection, and removal by adsorptive clays is another research action. Leadership is provided by Texas A&M University, the Senegalese Institute for Agricultural Research, and the Senegalese Institute of Food Technology.

Burkina Faso. The cultivar improvement program in Senegal is linked to improvement efforts in Burkina Faso to infuse superior germplasm. Integrated Pest Management (IPM) research is solving problems caused by damage from insect pests. Food technology research is directed toward development of better use of groundnut as a primary food and its delivery to the population. Leadership is provided by Texas A&M University, the University of Georgia, Alabama A&M University, and the University of Ouagadougou, Burkina Faso.

Mali. The cultivar improvement program in Senegal is linked to germplasm improvement in Mali, with leadership provided by Texas A&M University and the Institute for Economic Research, Mali.

Niger. The cultivar improvement program in Senegal is linked to germplasm improvement in Niger with leadership provided by Texas A&M University and the Nigerien National Institute for Agricultural Research.

Nigeria. Research to control rosette virus through development of resistant cultivars is led by the University of Georgia and Ahmadu Bello University, Institute of Agricultural Research with linkages to the cultivar improvement programs in Senegal and Burkina Faso.

Networks. The research program is enhanced by networks involving the interaction or linkages between the collaborative centers; cooperation with the ICRISAT Sahelian Center in research planning, implementation, and workshops; and cooperative research support with IRHO in Senegal.

In addition, support is provided in training to upgrade the skills of present researchers and provide graduate training to develop future researchers, purchase of expendable supplies and key items of research equipment, and communication of newly developed technology to farmers and to rural and urban consumers.

Status of the Groundnut Network Programs in Africa

R. Schilling[1]

Since 1950, two IRHO teams have carried out collaborative work on groundnut production problems common to Senegal and Burkina Faso. From 1984 onwards, IRHO actively cooperated with the ICRISAT Center at Hyderabad, India, and after 1987 with the ICRISAT Sahelian Center at Niamey, Niger, on groundnut research. In 1987, the "Groundnut Network" was set up which brought together research institutions from 14 African countries. Several joint projects are under way and program coordination has been undertaken.

Agronomy

Trials on groundnut-cereal rotation, carried out over several decades, have helped to monitor soil development and yields based on cropping practices and fertilizer application. In these trials, a foliar diagnostic technique was used to monitor mineral nutrition of the plant, to detect deficiencies, and to measure the effect of fertilizers over a vast network of multilocational experiments.

Breeding

The main breeding programs concentrate on improving plant tolerance for drought and *Aspergillus flavus,* leaf diseases (rust and leaf spot), and quality of table groundnuts. Adapted and productive varieties were selected and multiplied on a large scale, especially in Senegal.

Crop Protection

Preventative measures, varietal improvement (integrated physiology/breeding/pathology approach), and chemical control are used in studies on crop protection. Special attention is focussed on leaf diseases, aflatoxin, myriapod, and nematode control.

1. Agronome, Division Oleagineux Annuels, CIRAD-IRHO, II Square Petrarque, 75116, Paris, France.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Postharvest Techniques

The research on postharvest methods deals with seed production and processing techniques for table groundnuts. At present, all the operations can be mechanized (dehulling, sorting, seed coating with fungicide, and processing) in a controlled environment. The transfer of these techniques from the experimental stage to an industrial pilot project is under way.

Development Support

IRHO was entrusted with the supervision of the pilot projects to confirm and apply the research results. Thus, projects on seed multiplication, production to processing of table groundnuts, and nematode control are all carried out. The interaction between these projects and research activities allow researchers to adapt to the needs of the rural environment. This interaction also helps the IRHO program to become more coherent and effective.

Recent Progress and Future Strategies of the Groundnut Improvement Program at the ICRISAT Sahelian Center

B.J. Ndunguru[1], F. Waliyar[1], D.C. Greenberg[1], and P. Subrahmanyam[2]

Introduction

The goal of the Groundnut Improvement Program at the ICRISAT Sahelian Center (ISC), is to develop high-yielding breeding lines adapted to various agroecological zones in West Africa. These lines are also endowed with resistance to the biotic and abiotic stress factors that limit production and are suitable for small farmers in the region. While stress factors vary from region to region, drought, foliar diseases, viruses (rosette and peanut clump), aflatoxin, crop growth variability, and unsuitable cropping systems are the most frequent problems affecting yield and stability of groundnuts in the region. Therefore, the ISC program concentrates on these problems.

Progress

We made considerable progress in some of the areas. We improved drought screening technology and initiated studies to identify genotypes and management strategies to decrease the adverse effects of high temperatures.

We surveyed groundnut diseases in Niger, Burkina Faso, and Guinea, and estimated yield losses from foliar diseases in Niger. Multilocational trials for testing the stability of rust and late leaf spot resistance have been initiated. Yield losses due to diseases in Niger range between 19% and 38%.

Peanut clump virus (PCV) has been identified as one of the causes of crop growth variability and was observed in farmers' fields in Burkina Faso and Niger. The virus has a wide host range and among crops tested, only sunflower did not show the PCV antigen.

Crop growth variability can be effectively controlled by the soil application of pesticides or a combination of pesticides with farmyard manure. A syndrome of PCV and three species of nematodes *(Scutellonema, Telotylenchus,* and *Xiphinema* sp) was found to be associated with crop growth variability.

Several lines from the *A. flavus* resistant germplasm at ICRISAT Center which have significantly outyielded 55-437 showed a high level of resistance. Lines from ICRISAT Center (ICGV 87107, ICGV 87107 and ICGV 87110) as well as some introduced lines such as J 11 and AH 7227 showed good levels of *A. flavus* resistance.

---

1. **Principal Groundnut Agronomist and Team Leader; Principal Groundnut Pathologist; Former Principal Groundnut Breeder, ICRISAT Sahelian Center, B.P. 12404, Niamey, Niger (via Paris).**
2. **Principal Groundnut Pathologist, SADCC/ICRISAT Groundnut Project, Chitedze, P.O. Box 1096 Lilongwe, Malawi.**

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Rosette-resistant lines identified in West African programs and in the Southern African Development Coordination Conference (SADCC)/ICRISAT regional groundnut program in Malawi have been assembled and evaluated in Niger. Only RG 1 did not develop rosette symptoms. A hybridization program involving 55-437 and GH 119-20 that are susceptible to rosette but well adapted to West Africa and resistant lines RG 1 and KH 149A as source of resistance has been initiated at Lilongwe, Malawi.

After a survey of groundnut production practices, agronomic experiments in Niger examined sowing dates, varieties, fertilization, and cropping systems. Results from studies indicate that in a sole crop, it may be possible to select groundnut lines that will perform well as an intercrop. We initiated studies to estimate the importance of weeds in groundnut in order to define a strategy for their management. The nutritive value of groundnut haulms is being studied in collaboration with ILCA.

We have assembled 1500 breeding and germplasm lines from ICRISAT, SADCC, and West Africa and evaluated them in Niger, Nigeria, Benin, Cameroon, and Burkina Faso.

Future Plans

Our future research plans include refining screening techniques relating to tolerance for intermittent, mid-season and end-of-season drought, high temperature in the drier areas as well as for high humidity in the wetter areas.

Survey of groundnut diseases in different countries in the region will continue and we will screen material for sources of resistance to foliar diseases.

Research on the management of A *flavus* contamination will continue and all existing A *flavus* resistant cultivars will be evaluated in collaboration with the National Agricultural Research Systems (NARS).

Lines derived from crosses made in Malawi involving rosette resistant lines will be evaluated in West Africa for their adaptation. Screening for resistance to rosette will be carried out in collaboration with the Institute for Agricultural Research (IAR), Samaru.

We will continue to study the PCV/nematode syndrome in an effort to determine strategies for the management of crop growth variability.

Long-term effect of nutrients and crop residues on soil physical and chemical properties and groundnut yield will be continued. Research on components of cropping systems and how these components interact in the use and cycling of resources will be undertaken.

In breeding for adaptation, selection of early-maturing (90 days) varieties that are tolerant to drought will continue. Aflatoxin-tolerant material for drier areas and long-duration genotypes for the wetter areas will also be emphasized.

Groundnut pest problems will be investigated with the appointment of an entomologist in 1992.

Conclusion

We will help to develop the Institut national de recherches agronomiques du Niger (INRAN) Station at Tara, Niger, as a main location for ICRISAT groundnut breeding, pathology, and agronomy research and we will further strengthen our linkages with NARS.

Groundnut Research in West Africa and Sustainable Agriculture

L.J. Marenah[1]

The support of the Food and Agriculture Organization of the United Nations (FAO) to the groundnut industry includes :

1. The collection, analyses, and evaluation of production, consumption, trade, stocks, and price data for groundnuts and its products.
2. Providing an intergovernmental forum (the FAO Intergovernmental Group on Oilseeds, Oils, and Fats) for discussing problems affecting the world economy in the oilseeds sector, including groundnut, and harmonizing national policies or measures that have a bearing on the market; and
3. Technical assistance to governments in groundnut research, production, training, and related fields.

Research should encourage the development of cropping systems that are less dependent on costly inputs and the conservation of land and water resources to achieve sustainable agriculture as:

- The economic problems facing most West African countries restrict the imports of essential farm inputs;
- Inputs are expensive despite the severely limited financial resources available to farmers and;
- There is a worldwide concern over increasing land and environmental degradation.

Technical cooperation among countries in the subregion could lead to a more efficient and effective use of the scarce trained manpower, financial, and material resources available for research, development, and training.

Since adapted, high-yielding, and pest resistant varieties are the best gift, plant breeding can offer to the small farmers, breeding short-duration varieties, especially for areas that have short growing seasons, and varieties resistant to the most economically important pests and environmental stresses, such as drought, should receive greater emphasis. The rate of progress in the development and utilization of improved varieties may be accelerated through better support to plant genetic resource programs and regional research institutions that provide segregating hybrid populations to national institutions for selection under different agroclimatic and socioeconomic conditions.

1. Regional Plant Production and Protection Officer, FAO Regional Office, P.O. Box 1628, Accra, Ghana.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Significantly higher yields will result from controlling the various pre- and postharvest pests. Priority should be given to viral diseases, especially rosette, fungal diseases (leaf spots and rust), *Aspergillus flavus,* weeds, and storage pests. Integrated pest management (IPM), based on the minimum use of effective pesticides, offers the best means for a cheap, effective, and harmless plant protection system.

Low natural soil fertility and soil degradation are among the most important constraints to sustainable crop production in the subregion. Balanced fertilization, derived as far as possible, from organic and inorganic sources of plant nutrients is recommended. Techniques such as agroforestry, including alley cropping, tied ridges, and zero/minimum tillage are promising for soil fertility maintenance and moisture conservation but are yet to be fully evaluated technically and economically before their large-scale adoption by small farmers.

Traditional mixed/intercropping contributes to sustainable production by reducing soil erosion and water runoff. However, the contribution of nitrogen by groundnuts to companion crops in intercropping or to the nitrogen economy of the soil needs further investigations under different conditions. In view of the high cost of nitrogen fertilizer, studies on biological nitrogen fixation, including the selection of varieties most efficient in fixing nitrogen, need to be intensified.

Technical cooperation networks can be very a cost-effective means of promoting technical cooperation among institutions, but too many of them may negate the objective of maximum returns from scarce resources. The success of networks depends on a number of factors including proper planning and organization of activities and full support from members.

A close collaboration among research institutions such as ICRISAT, FAO, and national agricultural research organizations in the generation and transfer of improved technologies is imperative.

The CORAF Groundnut Network: Present Status and Future Prospects

A. Ba[1]

The Conference of African and French Heads of Agricultural Research (CORAF) has made great strides since 1986. It was set up in response to the need felt by agricultural research experts from 16 African countries and from France, for the establishment of a forum for scientific and technical cooperation. CORAF aims at pooling material, human, and scientific resources through networks in order to attain common objectives.

The problems of agricultural development at the subregional level are due to constraints which, with few exceptions, can be found within the same ecological areas. But, as the national research institutions do not have sufficient manpower and funds, it is not possible for them, in the short or medium term, to solve all the difficulties and attain self-reliance in food production. Therefore, it is hoped that regional cooperation can emerge between the different parties involved in agricultural research so as to avoid a sense of isolation in research work.

CORAF has, at present, 5 associated networks for plants : groundnuts, cotton, maize, cassava, and rice and a research network for drought resistance (R3S).

The future research activities for the Groundnut Network was outlined in the conclusions of the Third Plenary Conference of CORAF which was held at Antananarivo.

In fact, that Conference marked a decisive historical turning point in CORAF's development with a change of name to "Conference des responsables de recherche agronomiques africains" (Conference of African Heads of Agricultural Research). This new title gives it a truly African image. It also shows the commitment of African experts to take the future of agricultural research of the continent into their hands and to contribute to the emerging and developing African scientific community. It presupposes a qualitative progression both in concepts and performance.

One of the crucial aspects of this change is CORAF's wish to open the doors to African English-speaking countries working on important plant research programs around which the CORAF network is built. Converting this into a reality will be rewarding, particularly for the Groundnut Network which has many colleagues in these countries.

The setting up of a Steering Committee within each network is also an important step. In fact, by its very composition, the Committee will contribute towards creating a scientific critical mass and monitoring the network's activities. The need for outside assessment of the networks has been clearly reaffirmed.

A new era is ahead for the CORAF network. For its part, the Groundnut Network will make every effort to breathe new life into its work within this new framework, collaborating with other regional and international organizations which work on groundnuts, in order to promote this oilseed.

---

1. Coordinateur Reseau Arachide/CORAF, ISRA B.P. 199, Kaolack, Senegal.

Citation: ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1991. Summary Proceedings of the Second ICRISAT Regional Groundnut Meeting for West Africa, 11-14 Sep 1990, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT.

Recommendations of the Meeting

Working Group on Agronomy

1. The group observed that in most countries in the region the seed available to farmers was poor and scarce. In many cases, seed distribution is also a problem. The group was pleased that a groundnut network will be held on this topic in the near future and urged ICRISAT and producer countries to participate.
2. Crop management systems should be developed not only to improve agricultural production but also to ensure maintenance of soil fertility; water use efficiency; activity monitoring; disease and pest control; and protection of the environment.
3. As the region lacks qualified personnel at all levels, the group was pleased that the ICRISAT Sahelian Center (ISC) created a Training Center and recommended :
   - that ISC should encourage contacts between scientists; information dissemination; and pooling of groundnut research results;
   - that the ISC Training Center should assume responsibility for training research scientists, support and extension staff, and instructors.
4. Since most Of the national agricultural research systems in the region are very poorly funded, financial support should be given to them for collaborating in regional trials.
5. Attention was drawn to institutional and socioeconomic constraints that occur wherever recommendations are made for farmers. These recommendations should suit the technical skills and the financial means of the small farmers.
6. The group drew attention to the considerable postharvest losses and recommended that steps should be taken to develop effective postharvest technology, in particular for storing, conserving, and marketing groundnut products.
7. ICRISAT should help in strengthening and coordinating national groundnut research programs and services.

Working Group on Breeding

1. The group requested ISC, ICRISAT Center, and SADCC/ICRISAT to develop short-duration and segregating rosette-resistant material for national programs.
2. The group noted that germplasm collections had been carried out in Guinea and requested that groundnut germplasm should be collected from all the places of the region where it has not been previously done e.g., Cameroon.
3. National Programs should be more specific in their requests for material to ISC and ICRISAT Center by indicating seed color, seed size, oil content, etc.

4. National Program scientists should be trained up to degree level, since senior level groundnut research staff are lacking in most of these programs. ISC should also send to these programs, conclusions from workshops on ICRISAT's Training Program and future plans and explain how they could be utilized by these programs.
5. ICRISAT should collaborate with international organizations operating in the region to ensure better preparation (including translation into English or French) and dissemination of bilingual publications.
6. The heat unit system should be standardized and made simple for use by breeders in the region to define genotype growth duration.
7. ISC should take into account major breeding activities undertaken by the national programs. Such information should be made available to all other national programs. This would facilitate exchange of materials with specific traits, and exploit capabilities of these programs in germplasm screening.
8. A publication on groundnut breeding methods should be prepared to complement the published bulletin on hybridization.
9. Regional meetings should be held every two years and specialists' meetings should be organized by ISC on request, if funds are available.
10. The meeting noted that recommendations 2, 5, and 6 of the 1988 Plant Breeding Group had been satisfactorily implemented.

Working Group on Plant Protection

The group was pleased to note that some of the recommendations, made at the 1988 meeting, were beginning to be implemented:

- the Training Center will soon be opened,
- regional trials are being established,
- the groundnut disease manual is being published.

Consequently the Plant Protection Working Group renews and puts forth the following recommendations:

1. Considering the important role played by international institutions (IRHO, Peanut CRSP, ICRISAT, ORSTOM) in strengthening national research programs, it would be advisable for ICRISAT to coordinate scientific cooperation so that national programs can derive maximum benefit.
2. From the technical and scientific angle, the Group favored central coordination for plant protection and subcordination in three fields : pathology, entomology, and nematology.
3. The group recognizes the economic damage of viral diseases to groundnuts in West Africa and would like ICRISAT to help national programs coordinate research activities including breeding for resistance, epidemiology, vector ecology, and control methods.
4. ICRISAT should organize a discipline-specific meeting on : plant protection, breeding, agronomy, and groundnut utilization between two regional groundnut meetings. If, necessary funding is made available to national research programs, it would be possible for them to participate in meetings convened by other organizations which cannot finance their participation.
5. Emphasis should be placed on research by teams and by disciplines in programs and organizations in West Africa using a system centrally coordinated by ICRISAT. To avoid

duplication, national and international research programs need to cooperate with each other.

6. Training of national program researchers by international agencies is extremely important especially at the higher level (up to Ph.D.). This will help the scientists in the national programs to update their knowledge on the latest development in crop protection, and undertake meaningful research in their own countries.
7. The group was pleased that the groundnut disease manual would soon be available and hoped that similar publications on other crop pests would be brought out.
8. Strengthening of research facilities of national programs by the international agencies in the region should be seriously considered, since the effectiveness of the international programs will be greatly enhanced by strong, functional national institutes.

Working Group on Utilization

Reports from countries represented indicate that groundnuts play an important role in the socioeconomic life of people in Africa. Groundnuts are not only a food crop, a considerable source of proteins and calories but also a cash crop which allows a good part of the population to exercise a profitable commercial activity.

In view of the above, the Groundnut Utilization Working Group recommends that:

1. Research programs on groundnut processing and technology relating to crop protection, agronomy, and breeding programs should be strengthened.
2. Harvesting techniques and postharvest processing should be improved in order to guarantee hygienic standards and the market value of the product.
3. Special attention should be given to aflatoxin contamination risks connected to oil extraction techniques which are used in the rural areas;
4. The quality of groundnut-based products available on market should be improved and new products that combine groundnut derivatives and other cereal types should be developed.

   To meet these goals the Groundnut Utilization Working Group invites institutions such as FAO, ICRISAT, Peanut CRSP, IRHO, and CORAF's groundnut network to combine efforts in order:

   - To promote training for a larger number of food technology research scientists to improve the value derived from groundnut at the family and industrial level.
   - To support and strengthen national research programs devoted to artisanal and industrial groundnut processing technology.

Participants

O. Alabi
Lecturer/Researcher
IAR, Ahmadu Bello University
PMB 1044, Samaru, Zaria
Nigeria

A. Amalaman
Assistant de recherche
Institut des Savanes (IDESSA)
01 B.P. 635 Bouake
Cote d'Ivoire

Y. Atitso
Responsable, Recherche
d'accompagnement
Projet de developpement rural
de Notse-Notse
Direction de la recherche agronomique
B.P. 2318, Lome
Togo

A. Ba
Coordinateur Reseau Arachide / CORAF
ISRA
B.P. 199, Kaolack
Senegal

S.A. Baba
Entomologist
Head of Section
Nyankpala Agricultural Station
B.P. 483, Tamale
Ghana

A. Bationo
Soil Chemist
IFDC/ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

P. Baujard
Charge des recherches
ORSTOM
Laboratoire de Nematologie
B.P. 1386, Dakar
Senegal

E. Benamar
Interprete
26, rue Malivert
01630 Saint-Genis
France

Z. Bertin
Attache de recherche
INERA
03 B.P. 7192, Ouagadougou
Burkina Faso

S. Boubacar
Journaliste
Voix du Sahel
B.P. 361, Niamey
Niger

D.G. Cummins
Program Director
Peanut CRSP
University of Georgia
Griffin, GA 30 223-1797
USA

I. Dicko
Assistant a l'IDR
Universite d'Ouagadougou
B.P. 7021, Ouagadougou
Burkina Faso

M. Diourte
Phytopathologiste
IER/DRA/SRCVO
Sotuba
B.P. 438 Bamako
Mali

M.A. Djaya
Correspondant national
du reseau arachide
Ministere de l'Agriculture
N'Djamena
Chad

S. Drammeh
Research Officer
Grain Legumes and Oilseeds Programme
Department of Agricultural Research
Yundum Station
The Gambia

N. Essomba
Selectionneur d'arachide
IRA, Centre de Nkolbisson
B.P. Box 2067
Yaounde
Cameroon

D. Fatondji
Reseearch Assistant
ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

T. Gaillard
Interprete
25, avenue du Marechal de Lattre
92210 Saint-Cloud
France

N. Garba
Secretary
ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

J. Gautreau
Ingenieur Agronome
INERA
03 B.P. 7192, Ouagadougou
Burkina Faso

F. Gbaguidi
Librarian
ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

G. Grepin
Entomologiste
Institut national de
developpement rural
B.P. 296, Thies
Senegal

G.L Hildebrand
Principal Groundnut Breeder
SADCC/ICRISAT Groundnut Project
P.O. Box 1096, Lilongwe
Malawi

O. Idi
Selectionneur d'arachide
CNRA, Tarna
B.P. 240, Maradi
Niger

L.J. Marenah
Regional Plant Production
and Protection Officer
FAO Regional Office
P.O. Box 1628 Accra
Ghana

K.O. Marfo
Food Legumes Breeder
Agricultural Experiment Station
Nyankpala P.O. Box 52, Tamale
Ghana

A. Minoungou
Attache de recherche
INERA
Ouagadougou 03
B.P. 7192
Burkina Faso

S.M. Misari
Deputy Director
IAR, Ahmadu Bello University
PMB 1044, Samaru, Zaria
Nigeria

J.C. Mortreuil
Chef, Service Selection generale
ISRA, CNRA
B.P. 55, Bambey
Senegal

A. Mounkaila
Selectionneur d'arachide
CNRA, Tarna
B.P. 240, Maradi
Niger

N. Ndilou
Selectionneur
Centre de recherche agronomique
B.P. 28 Loudima
Congo

O. Ndoye
Chercheur
ISRA, Programme Arachide
B.P. 17, Nioro-du-Rip
Senegal

B.J. Ndunguru
Principal Groundnut Agronomist
ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

S.N. Nigam
Principal Groundnut Breeder
ICRISAT Center
Patancheru, Andhra Pradesh 502 324
India

P.E. Olorunju
Breeder/Virologist
IAR, Ahmadu Bello University
PMB 1044
Samaru, Zaria
Nigeria

O. Osman
Responsable, Cultures vivrieres
Societe centrafricaine de developpement
SOCADA, B.P. 997, Banguie
Central African Republic

B. Saidou
INERA
Station de recherche
agricole de Nyangoloko
B.P. 32, Nyangoloko
Burkina Faso

A.M. Sani
Technician
ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

O.A. Sanni
Chef, Division Protection
phytosanitaire
Station de recherche sur les
cultures vivrieres
Niaouli B.P. 3, Attogon
Benin

S. Savary
Chercheur
Department of Phytopathology
Wageningen Agricultural University
P.O. Box 8025
6700 EE Wageningen
The Netherlands

R. Schilling
Agronome
Division Oleagineux Annuels
CIRAD-IRHO, 11 Square Petrarque
75116 Paris
France

A.Sesay
Associate Scientist
Department of Biological Sciences
Njala University College
Institute of Agricultural Research
P.M.B. Freetown
Sierra Leone

C.E. Simpson
Professor/Peanut Breeder
Texas Agricultural Experiment Station
P.O. Box 292, Stephenville
Texas, 76401
USA

Bharat Singh
Professor, Peanut CRSP
Alabama A&M University
Department of Food Science
P.O. Box 274
Normal, AL 35762
USA

D. Soumano
Selectionneur et Chef du
Programme d'amelioration de l'arachide
IER/DRA/SRCVO
Sotuba, B.P. 438, Bamako
Mali

R. Tanko
Technician
ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

N.B. Tounkara
Chef, Filiere legumineuses alimentaires
CRAF
B.P. 156 Kindia
Guinea

A. Traore
Research Assistant
ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

A.S. Traore
Directeur, INSN-IDR
Departement de Biochimie
Universite de Ouagadougou
03 B.P. 7131
Burkina Faso

S. Traore
Attache de recherche
INERA
03 B.P. 7192, Ouagadougou
Burkina Faso

F. Waliyar
Principal Groundnut Pathologist
ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

J.H. Williams
Principal Physiologist
ICRISAT Sahelian Center
B.P. 12404, Niamey
Niger

RA 00183